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Cavity-Nesting Birds of Arizona and New Mexico Forests

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Sketches of typical cavity-nesting birds — in the text and on the c
are by wildlife artist Bob Hines of the U.S. Fish and Wildlife S
Washington, D.C.

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by

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Cavity-Nesting Birds of Arizona and New Mexico Forests

Cavity-nesting birds depend on dead and unmerchantable trees for their roosting and nesting cover. In the West these trees generally are considered a fire hazard and are removed during logging operations. Also dead trees are routinely removed from intensively used areas to eliminate the hazard of falling trees. Foresters and recreation managers are becoming more aware of the esthetic and economic value of non-game wildlife, however, and need information on bird habitat requirements so they can be considered in management plans.

At least 41 species of birds (table 1) are known to use tree cavities in five southwestern forest types (table 2). Although little information has been published concerning the effect of removing dead trees on cavity-nesting bird populations, Zeleny (1972), Power (1966), Elliott (1945), Balda (1970), Allen and Nice (1952), and Burns (1960) suggest that the population density of some birds may depend on suitable nesting sites. Michael and Thornburgh (1971) indicated that a reduction of bird populations within a forest could result in harmful increases in insect populations.

In this report we have summarized published data and personal observations on the habits of cavity-nesting birds in southwestern National Forests. The information should be helpful to forest managers planning timber harvests or preparing environmental impact statements.

Much of the literature cited in this paper did not list scientific names for the plants and animals mentioned in the text. The common name used was sometimes so indefinite that only the class could be determined. The appendices list the common names of plants and animals and the scientific names when they were referred to in the references, or when they could be determined from the common name used. Unless otherwise noted, North American distribution is taken from *Audubon Western Bird Guide* (Pough 1957), Arizona distribution from *The Birds of Arizona* (Phillips et al. 1964), and New Mexico distribution from *New Mexico Birds* (Ligon 1961). Nomenclature follows the American Ornithologists' Union: *The A.O.U. Check-list of North American Birds,* fifth edition, as amended by Supplement 32 in *The Auk,* 1973, 90(2)411-419. Percentages of the diet under "Food" refer to percent volume unless otherwise indicated.

Table 1.—Cavity-nesting birds in southwestern forest types

Common name	Page no.	Major forest type[1]					Tree use[2]		
		1	2	3	4	5	A	B	C
American kestrel	4		x	x	x			x	x
Screech owl	5			x	x	x		x	x
Whiskered owl	6			x	x	x		x	x
Flammulated owl	7	x	x	x	x	x		x	x
Pygmy owl	8		x	x				x	x
Elf owl	9				x	x		x	x
Spotted owl	10		x	x		x		x	x
Saw-whet owl	11		x	x				x	x
Coppery-tailed trogon	12				x	x		x	
Common flicker	13		x	x	x	x		x	x
Gila woodpecker	14			x	x	x		x	
Red-headed woodpecker	15			x	x		x	x	
Acorn woodpecker	16			x	x	x	x	x	x
Lewis' woodpecker	17		x	x			x	x	
Yellow-bellied sapsucker	18	x	x	x				x	
Williamson's sapsucker	19		x	x				x	
Hairy woodpecker	20	x	x	x	x		x	x	
Downy woodpecker	21	x	x	x			x	x	
Arizona woodpecker	22		x	x	x	x	x	x	
Northern three-toed woodpecker	23	x	x	x			x	x	
Ash-throated flycatcher	24			x	x			x	x
Olivaceous flycatcher	25			x	x	x		x	x
Violet-green swallow	26	x	x	x	x			x	x
Tree swallow	27		x	x				x	x
Purple martin	28		x	x	x			x	x
Black-capped chickadee	29	x	x	x				x	
Mexican chickadee	30	x	x	x				x	
Mountain chickadee	31	x	x	x	x			x	
Plain titmouse	32			x	x			x	
Bridled titmouse	33			x	x			x	
White-breasted nuthatch	34	x	x	x	x			x	
Red-breasted nuthatch	35	x	x	x				x	
Pygmy nuthatch	36	x	x	x	x			x	
Brown creeper	37	x	x	x	x			x	
House wren	38	x	x	x	x			x	
Brown-throated wren	39		x	x				x	
Winter wren	40		x	x	x			x	
Bewick's wren	41			x	x			x	
Eastern bluebird	42			x		x		x	x
Western bluebird	43		x	x				x	x
Mountain bluebird	44	x	x	x	x			x	x

[1] 1. Spruce-fir 2. Douglas-fir (Mixed conifer) 3. Ponderosa pi
4. Pinyon-juniper 5. Oak-woodland

[2] Primary use: A. Food B. Nest C. Perch

Forest type	Characteristic plants	Elevation	Annual rainfall	New Mexico	Arizona
		(feet)	(inches)		
Spruce-fir forest (subalpine forest, Hudsonian and Canadian Life Zones).	Engelmann spruce, subalpine fir.	8,500-12,000	30-35	High mountains, especially Sangre de Cristo Range, Jemez, Sacramento, and Mogollon Mountains.	High mountains, especially White Mountains, San Francisco Mountain, and Kaibab Plateau.
Douglas-fir forest (montane forest, Canadian Life Zone).	Douglas-fir, white fir, quaking aspen, limber pine.	8,000-9,500	25-30	High mountains in western two-thirds.	High mountains in eastern and northern.
Ponderosa pine forest (Transition Life Zone).	Ponderosa pine.	5,500-8,500	19-25	Mountains in western two-thirds and northeastern corner.	Mountains and plateaus in northeastern half.
Pinyon-juniper woodland (Upper Sonoran Life Zone).	Pinyon, Utah juniper, one-seed juniper, alligator juniper, Rocky Mountain juniper.	4,500-7,500	12-20	Plateaus, foothills, and mountains except eastern quarter.	Plateaus and mountains in northeastern half.
Oak woodland (Upper Sonoran Life Zone).	Emory oak, gray oak, Mexican blue oak, Arizona white oak.	4,500-6,000	12-20	Foothills and mountains in southern quarter.	Foothills and mountains in southeastern and central parts.

American kestrel (*Falco sparverius* Linnaeus)

Range: (Partially migratory) Breeds from Newfoundland, southern Quebec, northern Ontario, northwestern Mackenzie, and southeastern Alaska south through South America. Winters from central New England, central Illinois, Kansas, Utah, and southern British Columbia south.

Arizona: Apparently nests over entire State but becomes scar in high mountains during winter.

New Mexico: Usually nests at 5,000 to 7,000 feet throughout t State, but has been found nesting at lower elevations in t southeast.

Nest: Usually nests in natural cavities or old woodpecker hole mostly in dead trees. In Mississippi, Stockard (Bent 1961) fou kestrels nesting so densely that they could almost considered colonial; these birds were nesting in both natu cavities and abandoned woodpecker holes in a newly clea field where many old snags had been left standing. We ha found nests in woodpecker holes in dead ponderosa pine and lightning scars of live trees. Smith et al. (1972) reported that, 41 nests found in central Utah, 13 were in cliffs or buildings a 28 were in trees — 19 in flicker holes, 2 in magpie nests, and 7 natural cavities.

Food: Mostly insects, small birds and mammals, reptiles, ar amphibians. Where grasshoppers are plentiful, they a generally preferred (Bent 1961). Smith et al. (1972) found th insects accounted for almost 80 percent of total prey numbe but only 4 percent of the volume. Meadow mice, deer mice, ar house sparrows were the vertebrates taken most often, ar made up 96 percent of the volume.

Screech owl (*Otus asio* (Linnaeus))

Range: (Resident) from New Brunswick, Ontario, southern Manitoba, southern British Columbia, and southeastern Alaska to the Florida Keys, the U.S. Gulf Coast, and eastern Mexico.

Arizona: Common to abundant throughout open woods of the Sonoran Zones except in the northeast, where it is scarce. Follows junipers into the pine forest above Eagar. Prefers wide spacing of trees with grassy open spaces for hunting and feeding.

New Mexico: Found throughout the State, wherever there are hollow trees, from the lowest elevation in the south to as high as 8,000 feet in the north, but are most common in the oak-pine zone at about 7,000 feet.

Nest: Nests have been reported 5 to 50 feet above the ground in both natural cavities and flicker holes in apple, pine, poplar, and sycamore trees (Bent 1961).

Food: Major items are mice and insects. Fisher (1893) examined 255 screech owl stomachs and found birds in 38 (15 percent), mice in 91 (36 percent) and insects in 100 (39 percent). Other foods listed include shrews, rats, moles, flying squirrels, chipmunks, bats, crawfish, earthworms, lizards, frogs and toads, fish, spiders, and scorpions. The list of insects included June beetles, other beetles, cutworms, grasshoppers, locusts, crickets, cicadas, katydids, noctuid moths, caterpillars, and hellgrammites.

Whiskered owl (*Otus trichopsi* (Wagler))

Range: (Resident) From the Santa Catalina, Rincon, and Chiricahua Mountains in southern Arizona and the San Luis Mountains in southern New Mexico south to El Salvador.

Arizona: Resident in the southeast, where abundant in some the border mountain ranges in heavy Upper Sonoran Zone woo lands.

New Mexico: Not listed in most publications as occurring New Mexico, but Pough (1957) indicated it is found in the S Luis Mountains.

Nest: In natural cavities and old flicker holes, mostly in whi oak associations between 4,000 and 6,500 feet. Nests have be found in oak, walnut, juniper, and sycamores (Bent 1961).

Food: The principal diet is insects, including black cricket hairy caterpillars, moths, grasshoppers, large beetles, ar centipedes (Jacot 1931).

Flammulated owl (*Otus flammeolus* (Kaup))

Range: (Migratory) Breeds in orests of ponderosa pine from he Rocky Mountains west to the Pacific Coast and from British Columbia south to Guatemala.

Arizona: Abundant summer resident in most of the Transition Zone, particularly where oaks, or at least some understory, are present. Normally is not found in cut-over forests or in pure stands of ponderosa pine. Common in spruce-fir forests at least n the Pinoleno and Santa Catalina Mountains, and in aspens on Pinal Peak.

New Mexico: Distributed Statewide except on treeless mesas or plains, but is most common in the higher forested mountainous sections.

Nest: In flicker and other woodpecker holes; nests have been reported in dead pine, ash, and aspen trees (Bent 1961).

Food: Apparently largely, if not wholly, insectivorous, though it may occasionally capture a small mammal or bird. In the few stomachs that have been examined, items reported were various beetles, moths, grasshoppers, crickets, caterpillars, ants, other nsects, spiders, and scorpions (Bent 1961).

Pygmy owl (*Glaucidium gnom* Wagler)

Range: (Resident) Western North America, from Alaska to Guatemala, at 5,000 to 10,000 feet.

Arizona: Generally uncommon in woods of Transition Zone ar locally in Upper Sonoran Zone of western and central section

New Mexico: In ponderosa pine timber types from 6,000 fe upward; most common in the Sacramento and White Mountai and the Black Range.

Nest: Usually in old holes of woodpeckers, ranging in size fro the hairy woodpecker up to and including the flicker, from 8 20 feet above ground (Bent 1961).

Food: Most is probably mice and larger insects (grasshoppe etc.) but also feeds on smaller mammals, birds, amphibian and other insects (Bent 1961).

Elf owl (*Micrathene whitneyi* (Cooper))

Range: (Resident) Southern portions of U.S. along the Mexican border and south into central Mexico.

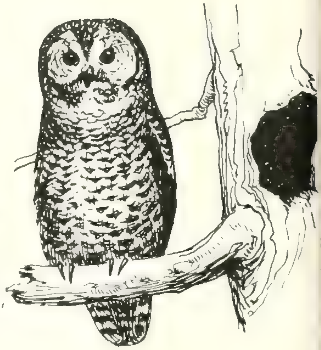
Arizona: Common summer resident in southern Arizona lowlands, less common in central Arizona, ranging through the live oak belt to the lower edge of Transition Zone.

New Mexico: Common summer resident in southwest adjacent to Arizona from the Mexican border into the Gila River Valley.

Nest: Most nests have been reported in abandoned woodpecker holes in saguaro cactus but in wooded areas nests have been reported in old woodpecker holes of cottonwood and sycamore trees (Bent 1961, Ligon 1961).

Food: Almost entirely insects and insect larvae such as crickets, grasshoppers, beetles, caterpillars, centipedes and others (Bent 1961).

Spotted owl (*Strix occidentalis* (Xantus))



Range: (Resident) Pacific coastal forest from southern British Columbia to California, and mountains of California, Arizona, New Mexico, and western Texas south into central and western Mexico.

Arizona: Uncommon resident of the heavily forested mountain and high mesas.

New Mexico: Has been recorded in all of the higher foreste mountains but nowhere common. Probably most common in th Mogollon, Black, and San Mateo ranges.

Nest: Usually nests in large tree cavities but will nest in holes i shaded rock gorges (Bent 1961).

Food: Various forest rodents and a few birds (Bent 1961).

Saw-whet owl (*Aegolius acadicus* (Gmelin))

Range: (Partially migratory) Breeds from Nova Scotia, Ontario, eastern Alberta, and southeastern Alaska to Connecticut, the mountains of North Carolina, northern Indiana, Missouri, central Arizona, and in the mountains of southern California through Mexico to Guatemala. In winter, found casually south to Georgia, Louisiana, and southern California.

Arizona: Resident, perhaps fairly common but not often detected, in the eastern, central, and perhaps northwestern mountains.

New Mexico: Few authentic State records; apparently nowhere common but widespread in the mountainous sections.

Nest: Apparently prefers old woodpecker holes, particularly those of flickers, which are nearly the same size (Bent 1961). We found one nest in an abandoned flicker hole in a dead ponderosa pine in the White Mountains of Arizona.

Food: Mostly mice, small rats, young red and flying squirrels, chipmunks, shrews, bats, and other small mammals; a few small birds such as sparrows, juncos, and warblers and a few insects have also been recorded (Bent 1961). Bailey (1928) listed wood mice as a principal food plus some rats, half-grown squirrels, chipmunks, and during the summer, many insects.

Coppery-tailed Trogon (*Trogon elegans* Gould)

Range (Partially migratory) Southern Arizona, southwest New Mexico and south Texas to Costa Rica.

Arizona: Uncommon summer resident of the Huachuca, Santa Rita, Chiricahua, and Santa Catalina mountains.

New Mexico: Rare in the Peloncillo and Animas mountains.

Nest: Generally in large deserted woodpecker holes 12 to 40 feet above ground (Bent 1940) and usually in cottonwood and sycamore snags (Ligon 1961).

Food: Little information on food habits but apparently feeds on both animal and vegetable foods. Bent (1940) reported on two birds. One contained adults and larvae of moths and butterflies, the other contained 68 percent insects and 32 percent fruits. Insect food included grasshoppers, praying mantids, stink bugs, miscellaneous bugs, leaf beetles, hawk moth larvae, sawfly larvae, and miscellaneous larvae. Vegetable food consisted of fruits of cissus and red pepper and undetermined plant fiber.

Common [Red-shafted] flicker *(Colaptes auratus cafer (Gmelin))*

Range: (Partially migratory) Breeds from southeastern Alaska to southern Quebec south to southern Mexico. In winter withdraws from the most northern parts of its range and higher mountains.

Arizona: Common summer resident of forested mountains and permanent resident of the wooded Lower Sonoran Zone.

New Mexico: Occurs Statewide during summer; moves southward during fall, and winters in southern part of the State.

Nest: Excavates nest holes, usually in old stubs or trees such as pine, cottonwood, willow, sycamore, and juniper at heights from ground level to 100 feet but usually between 8 and 25 feet; occasionally nests in holes in banks and in the sides of houses, gate posts, etc. (Bent 1964c). We have recorded 10 nests in the White Mountains of Arizona; 5 were in dead ponderosa pine, 2 in dead aspen, and 3 in live aspen at an average of 42 feet above ground.

Food: The favored food is ants; stomachs have been examined that contained over 2,000 individuals. Animal food makes up to 50 to 60 percent of the diet. In addition to ants, some beetles, caterpillars, crickets, spiders, codling moths, etc., are eaten. Acorns are the main vegetable item in the diet, but domestic grains and fruit are taken when available (Bent 1964c).

Gila woodpecker (*Centurus uropygialis* Baird)

Range: (Resident) Central Arizona and edges of adjacent states, west to Imperial Valley of southeast California, south through lower California to south Central Mexico.

Arizona: Common resident throughout Lower Sonoran Zone o southern and western Arizona; rather local in extreme southeast. Less common in low sections of the Upper Sonoran Zone in southern mountains.

New Mexico: Extreme southwest, particularly along the Gila River from the Arizona line to north of Cliff.

Nest: Mostly in saguaro cactus but uses dead trees at higher elevations (Ligon 1961).

Food: Consists of insects of various kinds, such as ants, beetles, grasshoppers, and fruit of saguaro cactus and mistletoe berries from cottonwood, oak, and mesquite trees (Bent 1964c).

Red-headed woodpecker (*Melanerpes erythrocephalus* (Linnaeus))

Range: (Partially migratory) Breeds from southern New Brunswick, southern Quebec, southern Ontario, southern Manitoba, and southeastern Alberta south to Florida and the Gulf Coast and west to central New Mexico, eastern Colorado, and eastern Wyoming.

Arizona: One bird reported in Chiricahua Mountains in 1894.

New Mexico: Occasional throughout the State except in the southwest. Never abundant but most common in the north-central section (Upper Rio Grande Valley), Pecos Valley, and along the Dry Cimarron River in the northeast.

Nest: Excavates nest holes, usually in dead tops or limbs of deciduous trees or in old stumps, more rarely in coniferous and fruit trees, at heights of 8 to 80 feet. Favors old dead stubs without bark (Bent 1964c).

Food: Beal (1911) found the diet to be 34 percent animal and 66 percent vegetable. Animal items were mainly insects, including ants, wasps, beetles, weevils, bees, grasshoppers, crickets, 17-year locusts, and caterpillars. Vegetable items were corn, dogwood berries, huckleberries, strawberries, blackberries, raspberries, mulberries, elderberries, wild black cherries, chokecherries, cultivated cherries, wild grapes, apples, pears, and various seeds. Predation on eggs and young of other birds has been reported.

Acorn woodpecker (*Melanerpes formicivorus* (Swainson))

Range: (Resident) Pacific Coast from southwestern Oregon to southern California, and Arizona, New Mexico, and Texas to South America, in oak woodlands and in coniferous forests where oaks occur scattered or as occasional groves.

Arizona: Common among large oaks in mountains througho the State except in the extreme north and in Baboquivaris, whe rare or local.

New Mexico: Common throughout practically all foreste mountains of the State except the extreme north.

Nest: Excavates nest holes and nests communally, mostly i large dead ponderosa pine but occasionally in live and dead oak sycamore, cottonwood, and large willow trees. They also us cavities in dead trees for communal roosting. Its old nest hole in dead pines are sought for nesting by other pine forest bird such as small owls, purple martins, violet-green swallows nuthatches, house wrens, and kestrels (Bent 1964c).

Food: Most of the diet is acorns, but almonds, walnuts, an pecans are taken when available. About 25 percent of the diet i animal material and includes grasshoppers, ants, beetles, an flies. Acorns are stored in bark or whitewood of dead pine tree for food supply (Bent 1964c). MacRoberts and MacRobert (1972) report that sap from several species of oaks is consume during winter, spring, and summer.

Lewis' woodpecker
(*Asyndesmus lewis* (Gray))

Range: (Partially migratory) Southern British Columbia and southern Alberta, east to South Dakota, west Kansas, and south o New Mexico, Arizona, and mid-California. Absent from the coastal fog belt. Winters south o northern Mexico.

Arizona: Fairly common resident of certain Transition Zone parks in San Francisco Mountains, rarer and local northward and eastward. Rare in White Mountains, with the only mid-summer record near Alpine.

New Mexico: Mostly in higher mountain parks and valleys in the north and uncommonly in the Mogollon and Sacramento Mounains.

Nest: Excavates nest holes, usually in large dead trees, in pine type or in burned or cutover dense pine or fir forest. From the literature, Bock (1970) summarized following nest data: Height range 1.5 to 51.8 meters; 47 nests in dead stubs and 17 in live trees; 29 nests in conifers, 31 in cottonwood and sycamore, 6 in oaks, 2 in power poles, 1 in juniper, and 1 in catalpa. Of 11 nest sites at Boca Reservoir, California, 10 were in dead ponderosa pines, the other in a hollow section of a living pine (Bock 1970).

Food: About two-thirds of the food consists of large black crickets, ants, beetles, flies, larvae of various kinds, and fruits of wild strawberries, serviceberries, salmonberries, pine seeds, uniper berries; the other one-third is acorns. These woodpeckers have been known to damage pomegranates and quinces near Tucson, Arizona, and fruit orchards in the northwest when he orchards were located near forested areas (Bent 1964c).

Yellow-bellied sapsucker
(*Sphyrapicus varius* (Linnaeus)

Range: (Migratory) Breeds from Newfoundland, the south end of James Bay, northern Manitoba, southern Mackenzie, and southeastern Alaska to New Hampshire, the Virginia Mountains, northern Ohio, central Missouri, New Mexico, and southern California. Winters from southern New Jersey, southern Ohio, Kansas, and southern British Columbia to the west Indies and Central America.

Arizona: Nests in Canadian Zone of mountains along and nor of Mogollon Plateau, and irregularly in the Hualapai Mountain Very rare except in parts of White Mountains, Blue Range, an farther west at Promontory Butte.

New Mexico: Nesting is largely confined to the Transition an Canadian Life Zones of all the mountainous areas in the Stat

Nest: Most nest records are from eastern United States, wher nest holes are excavated in large dead trees, usually near wate trees recorded were birch, elm, poplar, and butternut (Ber 1964c). Bailey and Niedrach (1965) indicate that, in Colorad most nests are in deciduous trees.

Food: As the name sapsucker implies, these birds utilize the sa from various trees, but it is difficult to determine the amoun taken. Food habits studies indicate that about 16 to 20 percen of the diet is cambium and bast. The remaining vegetabl portion of the diet includes fruits of dogwood, black alder Virginia creeper, wild blackberries, and some nuts. Anima matter eaten includes ants, beetles, wasps, and other insect but not any of the wood-boring larvae (Bent 1964c).

Williamson's sapsucker (*Sphyrapicus thyroideus* (Cassin))

Range: (Partially migratory) Breeds in British Columbia and Montana to mountains of southern California and northern New Mexico. Winters at lower elevations near breeding areas and south to mid-Mexico.

Arizona: Nests from Mogollon Rim northward, more or less commonly.

New Mexico: Confined in summer mostly to dense forests of the Canadian and Hudsonian Zones of the northern mountains.

Nest: Holes are excavated in dead or dying wood 5 to 60 feet above ground. Dawson (Bent 1964c) described the nest site as a pine tree beginning to die at the top, usually in a fairly sheltered situation. Other authors (Bent 1964c; Michael 1936) have reported nests in red firs, larches, white fir, and aspen but always in conifer associations. We have found six nests in Arizona in aspen (three in dead aspen and three in dead tops of living aspen trees).

Food: The small amount of information available indicates that about 87 percent of the diet is animal, nearly all of it ants, and that nearly all the rest is cambium (Beal 1911).

Hairy woodpecker (*Dendrocopos villosus* (Linnaeus))

Range: (Resident) Newfoundland, Ontario, southern Manitoba, southwestern Mackenzie, and northwestern Alaska south to Florida, the Gulf Coast, south-central Texas, southern Mexico, and southern California.

Arizona: Common to fairly common resident of coniferous forests throughout the State.

New Mexico: Common to nearly all forested mountains of the State above 6,000 feet.

Nest: Usually excavates nest holes in dead pine trees, frequently at a considerable height above ground (Bent 1964c). We found two nests 35 feet high in live aspen in Arizona.

Food: Prefers to feed on dead and diseased trees and stubs, probably because of increased availability of borers and grubs (Bent 1964c). Animal matter, which made up 79 percent of the diet (Beal 1911), consisted of round-headed and flat-headed borers and a few stag beetle larvae. Ants were second in importance, and weevils, curculios, engraver beetles, ground beetles, caterpillars, bugs, aphids, and other insects made up the rest. A variety of vegetable foods including blackberries, raspberries, corn, poison ivy, poison sumac, acorns, hazelnuts, beechnuts, and cambium make up the remaining 21 percent of the diet. Hairy woodpeckers, along with other species of woodpeckers, have been credited with reducing several forest pests including codling moth larvae in Nova Scotia (MacLellan 1958 and 1959) and bark beetles in Engelmann spruce (Olson 1953; Koplin and Baldwin 1970; Shook and Baldwin 1970).

Downy woodpecker (*Dendrocopos pubescens* (Linnaeus))

Range: (Resident) Newfoundland, Ontario, southern Manitoba, southwestern Mackenzie, and northwestern Alaska south to southern Florida, the Gulf Coast, southeastern Texas, southern Mexico, and southern California.

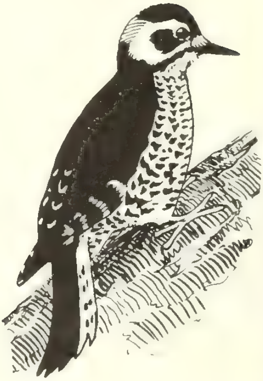
Arizona: Sparse in deciduous trees of Transition and Canadian Zones from White Mountains (where more common), Sierra Ancha, and San Francisco Mountains northward.

New Mexico: Sparse throughout the forested mountains from 6,000 to 8,000 feet; probably most common in the north.

Nest: Makes it own nest holes in branches or stubs 8 to 50 feet above ground, generally in dead or dying wood but sometimes in solid branches (Bent 1964c).

Food: Mostly insects, nearly all of which are economically harmful. Beal (1911) examined 723 stomachs and found the contents to be 76 percent animal and 24 vegetation. Beetles, mostly wood-boring larvae, made up 21.5 percent, ants 21 percent, caterpillars 16.5 percent, weevils 3 percent, and fruit (mostly wild) 6 percent; the remaining food items were not mentioned. Like the hairy woodpecker, the downy woodpecker has been credited with reducing forest pests (MacLellan 1958, 1959; Olson 1953).

Arizona woodpecker (*Dendrocopos arizonae* (Hargitt))



Range: (Resident) Mountains of southern Arizona and southwestern New Mexico to south-central Mexico.

Arizona: Fairly common resident of live oaks in southeastern Arizona, west and north to Baboquivari, Santa Catalina, and Graham Mountains, at 4,000 to 7,500 feet.

New Mexico: Occurs only in the extreme southwest corner of the State (Peloncillo and Animas Mountains), where it is common in the oak-juniper foothills up to 7,000 feet.

Nest: In Arizona, usually excavates nest holes in dead branches of walnut trees, but nests have been found in dead branches of oak and maple, and one nest was reported in a mescal stalk (Bent 1964c).

Food: Few details have been reported, but apparently the diet is mainly adult and larval insects, with some fruits and acorns (Bent 1964c).

Northern three-toed woodpecker (*Picoides tridactylus* (Linnaeus))

Range: (Resident) North to the limit of trees in North America, Europe, and Asia, south to northern New Hampshire, northern Michigan, northern Minnesota, and in mountains to southwestern Oregon and Arizona.

Arizona: Uncommon resident in Boreal Zones, rare in Transition Zone, from White to San Francisco Mountains and on Kaibab Plateau.

New Mexico: Found in greatest numbers around the higher peaks of the Sangre de Cristo Range; less numerous in San Juan, Jemez, and Zuni and sparingly in the highest parts of the Black and Mogollon Ranges.

Nest: Most reported nests have been 7 to 60 feet above ground in cavities of dead pine trees. Nests have also been found in dead aspen and spruce (Bent 1964c).

Food: The literature indicates this is one of the most beneficial woodpeckers. Bailey (Bent 1964c) indicated that over 75 percent of the diet consists of destructive wood-boring larvae of beetles. Beal (1911) estimated that each three-toed woodpecker annually destroys some 13,675 of the grubs most destructive to forests. Olson (1953), Shook and Baldwin (1970), and Yeager (1955) mention the benefits of the three-toed woodpecker in control of the spruce bark beetle.

Ash-throated flycatcher (*Myiarchus cinerascens* (Lawrence))

Range: (Partially migratory) Breeds from central Washington, northern Utah, and west-central Texas south and west through northern Mexico to the Pacific.

Arizona: Common summer resident throughout all but th densely wooded parts of the Sonoran Zones.

New Mexico: Common summer resident throughout the Stat except along the east side where it is less numerous. Ranges u to 7,500 feet in the more mountainous sections.

Nest: Usually nests in woodpecker holes and natural cavities but also exposed pipes, nest boxes, and knotholes of mesquite ash, oak, sycamore, juniper, and cottonwood trees (Bent 1963).

Food: About 92 percent of the diet is animal matter (beetles, bees, wasps, bugs, flies, caterpillars, moths, grasshoppers, other miscellaneous insects and spiders) and 8 percent vegetable (mistletoe, berries, and other fleshy fruits) (Bent 1963).

Olivaceous flycatcher (*Myiarchus tuberculifer* (Lafresnaye and D'Orbigny))

Range: (Partially migratory) Breeds from mountains of southeastern Arizona to South America.

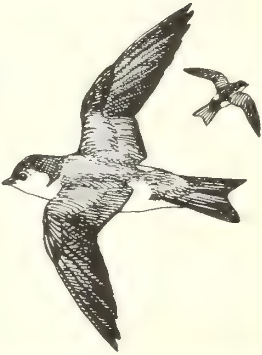
Arizona: Summer resident of denser live oaks, and higher Lower Sonoran riparian associations of Santa Cruz River drainage, from Guadalupe Mountains.

New Mexico: Rare but has been found in San Luis Mountains and just south of the International Boundary in Devil's Canyon.

Nest: Nests in natural cavities and old woodpecker holes; most nests have been reported in oaks (Bent 1963).

Food: Limited evidence on food habits indicates the major food items are small insects including grasshoppers, termites, mayflies, treehoppers, miscellaneous bugs, moths, bees, wasps, and spiders (Bent 1963).

Violet-green swallow *(Tachycineta thalassina* (Swainson))



Range: (Migratory) Breeds from central Alaska and central Alberta south to northern Mexico and east to western South Dakota and western Nebraska. Winters from Mexico, occasionally southern California, to Costa Rica.

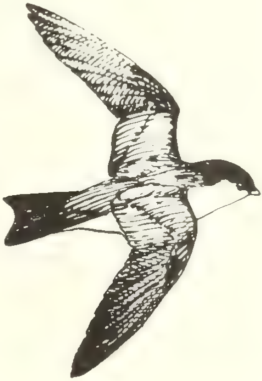
Arizona: Common summer resident in most of the Transition and Canadian Zones.

New Mexico: Uncommon but widespread in the yellow pine zone from about 7,000 feet in the Sacramento and Mogollon Mountains and the Black Range to more than 11,000 feet in the Sangre de Cristos.

Nest: In holes, cavities, and crevices in a variety of situations. Where the birds are abundant, the demand for nest sites is sometimes greater than the supply, and practically any available cavity may be used. Where nesting sites are numerous, the swallows often form colonies, with many nests in a suitable tree or cliff. Morrison (1888) "has seen as many as 20 pair in a single dead pine and four or five pair in one limb which had been used first by the woodpeckers" in Colorado (Bent 1963). Violet-greens have been reported to use old nests of cliff swallows and even burrows of bank swallows. In Arizona, they usually nest in abandoned woodpecker holes high up on the mountains in the pine belt. We have found 28 nests in the White Mountains of Arizona; three were in dead tops of ponderosa pines, while all others were in dead ponderosa pines. Nests ranged from 30 to 70 feet above ground.

Food: Apparently, the diet is exclusively insects taken on the wing. It includes leafhoppers, leaf bugs, flies, flying ants, and some wasps, bees, and beetles (Bent 1963).

Tree swallow (*Iridoprocne bicolor* (Vieillot))



Range: (Migratory) Breeds from Newfoundland, northern Manitoba, Mackenzie, and northern Alaska to Maryland, north-central Louisiana, Colorado and southwestern California. Winters from North Carolina and Gulf Coast, northern Mexico, and southern California through Cuba to Guatemala.

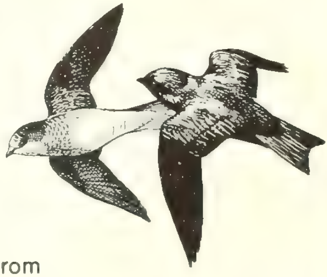
Arizona: Probably does not nest in Arizona, but does nest as far south as Durango, Colorado.

New Mexico: Only one nest reported for the State, on the Bosque del Apache Wildlife Refuge.

Nest: Prefers to nest in natural cavities and old woodpecker holes, but will utilize nest boxes. Usually nests in rather open forests, although large colonies have been found nesting in cavities of dead trees projecting out of water (Bent 1963).

Food: About 80 percent of the diet is animal (beetles, ants, flies, grasshoppers, dragonflies, spiders), and the rest fruits such as bayberry (Beal 1918).

Purple martin (*Progne subis* (Linnaeus))



Range: (Migratory) Breeds from Canada south to Mexico.

Arizona: Breeds in the Transition Zone of open parts of th entire Mogollon Plateau region, even to such areas as William Mount Trumbull, the Natanes Plateau, the Sierra Ancha, and th Prescott region, and also in the Chiricahua Mountains, but absent from the other mountains of southern Arizona, the Gran Canyon, and the northeast. Also breeds in saguaro association of south-central Arizona west to the Ajo Mountains and nort near Picacho, Florence, Roosevelt Lake, and the lower Sa Pedro Valley.

New Mexico: Ligon (1961) reported sparse nesting in all of th higher forested mountains of the State, usually from 7,000 t 9,000 feet.

Nest: The western purple martin has not adapted to nest bo nesting as has the eastern form (Bunch 1964), but instea depends on holes made by woodpeckers, usually in tall pines i relatively open timber stands (Bent 1963). Also nests in holes o saguaro cactus. We have observed as many as six pairs nestin in one dead ponderosa pine near Cibecue, Arizona.

Food: Apparently is almost entirely insects, most taken on the wing. Beal (1918) found only a few spiders; the rest were true insects and included ants, wasps, house flies, long-legge tipulids, stink bugs, treehoppers, negro bugs, May beetles, dung beetles, cotton boll and clover weevils, and a few bees.

Black-capped chickadee (*Parus atricapillus* Linnaeus)

Range: (Partially migratory) The northern hemisphere. In North America from Newfoundland, central Quebec, northern Ontario, central Mackenzie, and central Alaska to northern New Jersey, northern California mountains, Indiana, southern Missouri, northern New Mexico and northwestern California. In winter south to Maryland and central Texas.

Arizona: Possible winter visitor in Mogollon Plateau.

New Mexico: Confined almost wholly to the northern high forested mountains from about 7,500 feet to timberline. Most common in the mountains east of the Rio Grande from Santa Fe and Pecos northward.

Nest: Sometimes nests in natural cavities and deserted holes of woodpeckers, but usually makes its own hole in decaying wood of dead trunks or limbs of deciduous trees (Bent 1964a).

Food: The diet is about 70 percent animal and 30 percent vegetable (Bent 1964a). Mast, chiefly from coniferous trees, and fruits of such plants as bayberry, poison ivy, and blueberries make up the bulk of the vegetable part of the diet. A variety of animals are eaten, mainly insects; most important are caterpillars and eggs of lepidoptera, spiders, beetles, true bugs, ants, and sawflies.

Mexican chickadee (*Parus sclateri* Kleinschmidt)

Range: (Resident) Pine and spruce forests of Chiricahua Mountains of southeastern Arizona (7,000 to 10,000 feet) and mountains of extreme southwestern New Mexico.

Nest: Excavates nest hole in dead trees or branches (Ben 1964a).

Food: No information found in the literature.

Mountain chickadee (*Parus gambeli* Ridgway)

Range: (Resident) Mountains from Canada to western Texas, New Mexico, Arizona, and southern California.

Arizona: Common in pine and spruce-fir forest, locally into pinyon-juniper in northeastern Arizona, and throughout mountains except Hualapais and Mexican border ranges.

New Mexico: Common summer resident in mountain areas from 7,500 feet to timberline. May be found as low as 5,000 feet at Shiprock and Guadalupe Mountains during winter.

Nest: Usually nests in natural cavities or old woodpecker holes; probably does not excavate a cavity if it can find one already made. Nests vary from 2 to 80 feet above ground, but usually are below 15 feet (Bent 1964a). Nests have been found in pine stumps, aspen, and under rocks. We have found nests in both aspen and dead ponderosa pine trees in Arizona.

Food: Food habits studies of the mountain chickadee are apparently lacking. Telford and Herman (1963) collected 10 birds in the Inyo National Forest where there was an infestation of lodgepole needle miner, and found 639 needle miner caterpillars in their stomachs.

Plain titmouse (*Parus inornatus* Gambel)

Range: (Resident) From southern Oregon, northern Nevada, northern Utah, and central Colorado to west Texas, southern New Mexico, and southern California.

Arizona: Fairly common in Upper Sonoran Zone of northwes ern, northern, central and, locally, southeastern Arizona.

New Mexico: Common in the wooded foothills of the Upper Sonoran Zone east to Guadalupe and Capitan Mountains Montoya, and Dry Cimmarron. Usually from 5,000 to 7,000 feet

Nest: Usually in natural cavities or old woodpecker holes, but one bank nest has been reported. Most reported nests have been in oaks 2 to 23 feet above ground (Bent 1964a).

Food: Beal (Bent 1964a) examined 76 stomachs and found 43 percent animal material (bugs 12 percent, caterpillars 11 percent, beetles 7 percent, ants and wasps 6 percent, daddy longlegs and grasshoppers 5 percent, spiders 1 percent, and 1 percent unreported) and 57 percent vegetable material (cherries and pulp of larger fruit and leaf galls 32 percent, seeds of poison oak and weeds 25 percent).

Bridled titmouse (*Parus wollweberi* (Bonaparte))

ange: (Resident) Central and outheastern Arizona, south-estern New Mexico, south to outhern Mexico.

rizona: Common in southeastern and central Upper Sonoran oodlands, 5,000 to 7,000 feet.

ew Mexico: Uncommon in Animas and Peloncillo Mountains; orth to Alma and the Pinus Alto Mountains, from 5,500 to 6,500 et.

est: Nearly all recorded nests have been in natural cavities of ead and living oak trees 4 to 28 feet above ground (Bent 1964a).

ood: No published information found, but the diet is probably milar to that of other members of this genus. All live in similar abitats and spend much of their time foraging in crevices in the ark, on the trunks, and on branches of oaks, presumably unting for adults, larvae, and eggs of insects (Bent 1964a).

White-breasted nuthatch (*Sitta carolinensis* Latham)

Range: (Resident) From southern Quebec, central Ontario, southern Manitoba, and southern British Columbia to Florida, the Gulf Coast, and southern Mexico.

Arizona: Rather common throughout Transition and Lowe Canadian Zones, also locally among larger trees of Uppe Sonoran Zone.

New Mexico: Quite common in practically all forested area from 7,000 to 8,000 feet, and has been noted up to 10,000 feet i the Mogollon Mountains.

Nest: Usually nests in natural cavities or old woodpecker holes though has been reported to excavate nest holes in decaye trees (Bent 1964b). We have found nests in dead aspen and i dead portions (lightning strikes) of live ponderosa pine.

Food: Feeds freely on beechnuts, acorns, hickory nuts, an maize, and is fond of sunflower seeds. Nearly all winter food i mast, but much animal food is taken in spring and summe chiefly beetles, spiders, caterpillars, true bugs, ants, flies grasshoppers, moths, and millipedes (Bent 1964b). Among th insect foods are several forest pests, including nut weevils locust seed weevils, roundheaded woodborers, leaf beetles treehoppers, psyllids, scale insects, caterpillars, and ants.

Red-breasted nuthatch (*Sitta canadensis* Linnaeus)

Range: (Partially migratory) Breeds from Newfoundland, southern Quebec, northern Manitoba, central Yukon, and southeastern Alaska, to Massachusetts, southwestern North Carolina mountains, Michigan, Colorado, and southern California mountains. In winter occasionally reaches northern Florida, the Gulf Coast, and northern Mexico.

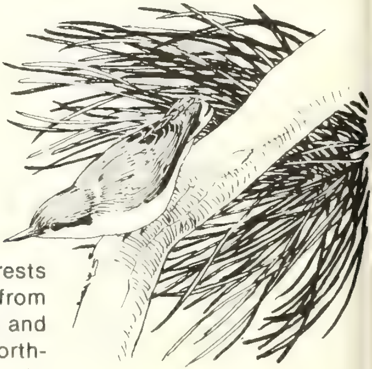
Arizona: Common resident in all, or nearly all, of the Boreal Zones. During fall sometimes found in Transition and Sonoran Zones, usually in large trees but casually in desert shrubs.

New Mexico: Uncommon fall and winter visitor, but apparently does not nest in New Mexico.

Nest: Usually excavates nest holes 5 to 40 feet above ground in rotten stubs or branches of dead trees, but sometimes uses old woodpecker holes; has been known to nest in bird boxes (Bent 1964b). Nests have been reported in birch, poplar, deadwood of living cottonwood, oak, and ponderosa pine.

Food: Little is known of the food taken, but this nuthatch is fond of seeds of pines, spruces, and other coniferous trees. The animal food is known to include beetles, hymenoptera, spiders, and ribbed pine borers. Sometimes feeds on flying insects like a flycatcher (Bent 1964b).

Pygmy nuthatch (*Sitta pygmaea* Vigors)



Range: (Resident) Pine forests of western North America from southern British Columbia and northern Idaho south to northern Lower California and southeastern Mexico.

Arizona: Abundant in ponderosa pines throughout Arizona an to some extent in adjacent heavy pinyon-juniper.

New Mexico: Found throughout the State in all foreste mountains. Common in northern Santa Fe County from 7,500 t 10,000 feet.

Nest: Nearly all reported nests have been from 8 to 60 feet abov ground in cavities of pine or dead remains of pine tree excavated by the bird (Bent 1964b). We found 20 nests in th White Mountains, all in dead ponderosa pine trees.

Food: About 80 percent of the diet is animal material, mostl wasps and spittle insects, including some ants, beetles, an caterpillars; the balance is nearly all seeds of conifers (Ber 1964b).

Brown creeper (*Certhia familiaris* Linnaeus)

Range: (Partially migratory) Breeds throughout much of the northern hemisphere. In North America from Nova Scotia, eastern Ontario, southern Manitoba, and central Alaska south to Massachusetts, North Carolina mountains, Indiana, and eastern Nebraska, and in the western mountains south to northern Nicaragua. Winters to southern Florida, the Gulf Coast, and central Texas.

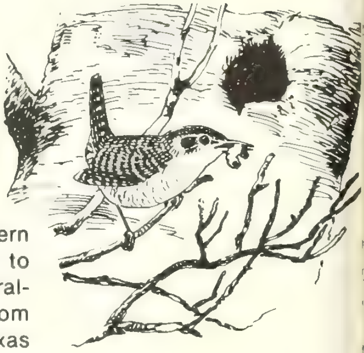
Arizona: Rather common summer resident of Boreal Zones and in the south, the Transition Zone, throughout Arizona, wintering uncommonly through Transition Zone and Upper Sonoran woodlands.

New Mexico: Largely confined to forested mountains at 7,000 to 11,000 feet; rarely in the Animas and Peloncillo Mountains.

Nest: Sometimes nests in natural cavities and old woodpecker holes, but generally makes its nest between the loose bark and the trunk of a large dead tree (Bent 1964b).

Food: Few details are known, but the diet is mainly insect, including weevils, leafhoppers, flat bugs, jumping plant lice, scale insects, eggs of katydids, ants, and other small hymenoptera, sawflies, moths, caterpillars, cocoons of the leaf skeletonizers, pupae of the codling moth, spiders, and pseudoscorpions (Bent 1964b). The small amount of vegetable matter eaten is chiefly mast.

House wren (*Troglodytes aedon* Vieillot)



Range: Breeds in the western U.S. from Canada south to Mexican border and central-western Texas; winters from central California and Texas south into Mexico.

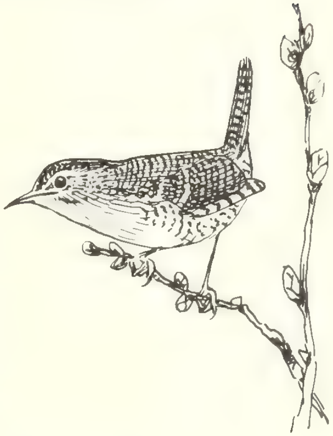
Arizona: Common summer resident in dense brush and fallen trees from Transition Zone to timberline in all forested mountains. Winters commonly in better-vegetated areas of Lower Sonoran Zone of the Southwest and the Lower Colorado Valley east to the Phoenix region, Tucson, and Patagonia.

New Mexico: Common in practically all wooded foothills and forested mountains up to 10,000 feet. Less common at higher elevations, but has been reported to timberline in the Sangre de Cristo Range.

Nest: Utilizes many sites including bank holes, crevices in rocks, deserted buildings, and cavities in trees. Usually nests less than 10 feet above ground in cavities or crevices in stumps, fallen or standing trees, including old woodpecker holes, but also accepts nearly any form of bird box (Bent 1964b; Robbins et al. 1966).

Food: Nearly all of the diet is animal material including beetles, caterpillars, bugs, grasshoppers, ants, etc. (Bent 1964b).

Brown-throated wren (*Troglodytes brunneicollis* Sclater)



Range: (Partially migratory) Mountain woodlands from southern Arizona to Oaxaca.

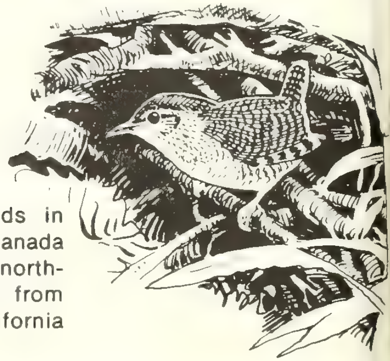
Arizona: Uncommon resident at 7,000 to 8,000 feet in southeastern Arizona mountains.

New Mexico: Not reported in New Mexico.

Nest: In cavities or old woodpecker holes in tree trunks or limbs, and will sometimes occupy nest boxes and recesses about buildings (Pough 1957).

Food: No published information, but the diet is probably similar o that of the western house wren.

Winter wren (*Troglodytes troglodytes* (Linnaeus))



Range: (Migratory) Breeds in evergreen forests from Canada to central California and northern Colorado. Winters from Canada to southern California and New Mexico.

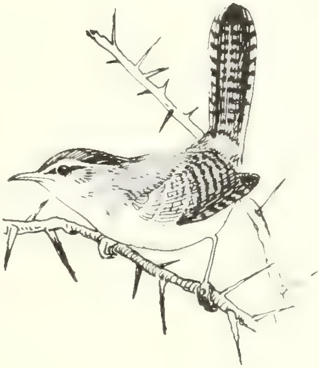
Arizona: Local and rare winter resident, generally in the mos dense brush of the more permanent streams of Transition anc adjacent zones. Records are listed from Grand Canyon, Oa Creek, and White, Huachuca, and Santa Catalina Mountains.

New Mexico: Rare visitor September to April.

Nest: In small holes and crannies in upturned roots or faller logs, and fire holes in half-burned stumps (Bent 1964b).

Food: Details have not been published, but the diet appears tc be largely or entirely adult and larval insects (Bent 1964b).

Bewick's wren (*Thryomanes ewickii* (Audubon))



ange: (Partially migratory)
eeds from central Pennsyl-
nia to Michigan, southern
ebraska, southern Utah, and
uthern British Columbia to
estern South Carolina, central
abama, central Arkansas, and
uthern Mexico. Wanders to
ntral Florida and the Gulf
ast in winter.

izona: Common resident in Upper Sonoran brush and
odland south of the Salt and west of the Verde Valley;
mmer resident locally and generally uncommon in pinyon-
iper zone over the rest of the State, and in mesquite-willow-
ttonwood associations along parts of Lower Sonoran Zone
ers.

w Mexico: Fairly common in sections of oak, pinyon, and
iper foothills mainly in southern half of the State from 4,000
7,000 feet. Ligon (1961) reports the Bewick's wren most
mmon in foothills of the Black, Mogollon, and Guadalupe
nges, Animas and Peloncillo Mountains.

st: Away from man, nests in knotholes in fallen trees in
ods or open fields, or in natural cavities or woodpecker holes
trees. Around civilization, will use holes in fence posts, tin
ns, empty barrels, bird boxes, deserted automobiles, and
vices in stone, brick, or tile walls (Bent 1964b).

od: The Bewick's wren is probably an insectivorous bird, as
the rest of the wrens, but apparently no intensive food habit
idies have been made.

Eastern bluebird (*Sialia sialis* (Linnaeus))

Range: (Partially migratory) Breeds from Newfoundland, southern Quebec, northern Ontario, and southern Manitoba south to southern Florida, the Gulf Coast, and Honduras; west to eastern Montana, eastern Colorado, west-central Texas, southeastern Arizona, and Sinaloa. Winters from southern New England and southern Michigan south.

Arizona: Rare and local resident in the live oaks and nearb pines from the Huachuca Mountains west to beyond Nogales Possibly in Chiricahua Mountains also.

New Mexico: Not reported as occurring in New Mexico.

Nest: In natural cavities and woodpecker holes, and has adapte well to nesting in man-made structures (Bent 1949).

Food: Nearly 70 percent of the diet is animal material, mainl grasshoppers, crickets, katydids, and beetles but with som ants, wasps, bees, bugs, moths, caterpillars, spiders, myriapods, towbugs, snails, and angleworms (Bent 1949). Th vegetable portion of the diet is largely wild fruits.

Vestern bluebird (*Sialia nexicana* Swainson)

nge: (Partially migratory) eeds from British Columbia, stern Montana, and central lorado to Central America. atters in winter, often to wer elevations.

izona: Common summer resident in open Transition and lower nadian Zones (and in the northeast, among the larger trees of per Sonoran woodlands) west to the Santa Catalina, adshaw, and the Hualapai Mountains and Mount Trumbull. t so common in southern mountains.

w Mexico: Breeds throughout practically all forested moun- ns of New Mexico from 6,500 to 9,000 feet, usually among nderosa pines.

st: Usually in old woodpecker holes but will use natural vities. Nests have been reported in oak, sycamore, and pine es. In Monterey County, California all nests found were from o 40 feet above ground in pine stumps or trees (Bent 1949). is bluebird, like the eastern, also readily nests near houses in d boxes.

od: Beal (Bent 1949) examined 217 stomachs and found 72 rcent animal material (grasshoppers 21 percent, caterpillars percent, useful beetles 9 percent, other beetles 16 percent, ts 5 percent, other hymenoptera 1 percent) and 28 percent getable material, mostly wild fruits including elderberries, stletoe berries, blackberries or raspberries, prunes, cherries, d a few weed seeds.

Mountain bluebird (*Sialia currucoides* (Bechstein))

Range: (Partially migratory) Breeds from southeastern Manitoba, central Saskatchewan, northwestern British Columbia, and southern Yukon south to Chihuahua and from western Nebraska to the Cascade, Sierra Nevada, and San Bernardino Mountains. Winters from Colorado to Oregon south through northern Mexico and east to Kansas and eastern-central Texas.

Arizona: Common summer resident of northern open areas fr pinyon-juniper woodland up to timberline, south to the ent Mogollon Plateau, and west to Ashfork and beyond Mou Trumbull.

New Mexico: Common summer resident throughout the forest mountains, from the southern portion of the Black and Pin Altos Ranges northward to the Colorado line and east to t Sacramento and Capitan Mountains.

Nest: Like other bluebirds, usually nests in natural cavities or old woodpecker holes, but also readily nests in man-ma structures and in almost any available cavity near hum habitation. We have found nests in woodpecker holes a natural cavities in dead ponderosa pine in the White Mountai of Arizona.

Food: Probably more insectivorous than other bluebird Studies indicate that nearly 92 percent of the diet is anim material, including miscellaneous beetles, weevils, ants, bee wasps, cicadas, stinkbugs, negro bugs, assassin bug jassids, flies, caterpillars, grasshoppers, locusts, and cricke (Bent 1949). Vegetable items were currants, grapes, elde berries, sumac seeds, mistletoe berries, hackberry seed Virginia creeper seeds, and cedar berries.

LITERATURE CITED

Allen, Robert W., and Margaret M. Nice.
1952. A study of the breeding biology of the purple martin — (*Progne subis*). Am. Midl. Nat. 47(3):606-665.

Bailey, Alfred M. and Robert J. Niedrach.
1965. Birds of Colorado. Denver Mus. Nat. Hist. Vol. 2, 895 p.

Bailey, Florence M.
1928. Birds of New Mexico. New Mexico Dep. Game and Fish, 807 p.

Balda, Russell P.
1970. Effects of spring leaf-fall on composition and density of breeding birds in two southern Arizona woodlands. Condor 72(3):325-331.

Beal, F. E. L.
1911. Food of the woodpeckers of the United States. U.S. Dep. Agric. Bull. 37, 64 p.

Beal, F. E. L.
1918. Food habits of the swallows, a family of valuable native birds. U.S. Dep. Agric. Bull. 619, 28 p.

Bent, Arthur C.
1940. Life histories of North American cuckoos, goatsuckers, hummingbirds and their allies. 506 p. U.S. Gov. Print. Off. Washington, D.C.

ent, Arthur C.
1949. Life histories of North American thrushes, kinglets, and their allies. 439 p. U.S. Gov. Print. Off. Washington, D.C.

ent, Arthur C.
1961. Life histories of North American birds of prey (Part II) 482 p. Dover Publications, Inc., New York.

ent, Arthur C.
1963. Life histories of North American flycatchers, larks, swallows, and their allies. 533 p. Dover Publications, Inc., New York.

ent, Arthur C.
1964a. Life histories of North American jays, crows, and titmice (Part II) 495 p. Dover Publications, Inc., New York.

ent, Athur C.
1964b. Life histories of North American nuthatches, wrens, thrashers, and their allies. 475 p. Dover Publications, Inc., New York.

ent, Arthur C.
1964 c. Life histories of North American woodpeckers. 334 p. Dover Publications, Inc., New York.

Bock, Carl F.
1970. The ecology and behavior of the Lewis woodpeck (*Asyndesmus lewis*). Univ. Calif. Publ. in Zoology, Vol. 9 100 p. Univ. Calif. Press, Berkeley and Los Angeles.

Bunch, Carl H.
1964. Nesting of the western purple martin. Murrelet 45(1):1 11.

Burns, Herbert.
1960. The economic importance of birds in forests. Bird Stu 7(4):193-208.

Elliott, Charles.
1945. Woodman, spare that "Wolf" tree! Am. For. 51(10):48 490.

Fisher, A. K.
1893. The hawks and owls of the United States and their rel tion to agriculture. Bull. 3, 210 p. U.S. Gov. Print. Off Washington, D.C.

Jacot, E. C.
1931. Notes on the spotted and flammulated screech owls Arizona. Condor 33(1):8-11.

Koplin, James R., and P. H. Baldwin.
1970. Woodpecker predation on an endemic population Engelmann spruce beetles. Am. Midl. Nat. 83(2):510-515

Ligon, J. Stokley.
1961. New Mexico birds. 360 p. Univ. N. M. Press, Albuque que.

Little, Elbert L. Jr.
1950. Southwestern trees — A guide to the native species New Mexico and Arizona. U.S. Dep. Argic., Agric. Hand 9, 109 p.

MacLellan, C. R.
1958. Role of woodpeckers in control of the codling moth Nova Scotia. Can. Entomol. 90(1):18-22.

MacLellan, C. R.
1959. Woodpeckers as predators of the codling moth in Nov Scotia. Can. Entomol. 91(11):673-680.

MacRoberts, Barbara R., and M. H. MacRoberts.
1972. A most social bird. Nat. Hist. 81(10):44-51.

Michael, Charles W.
1936. Nesting of the Williamson sapsucker. Condor 37(4) 209-210.

Michael, Edwin D., and P. I. Thornburgh.
1971. Immediate effects of hardwood removal and prescribe burning on bird populations. Southwest. Nat. 15(3):359 370.

lson, Harold.
1953. Beetle rout in the Rockies. Audubon Mag. 55(1):30-32.

hillips, Allan, J. Marshall, and G. Monson.
1964. The birds of Arizona. 212 p. Univ. Ariz. Press, Tucson.

ough, Richard H.
1957. Audubon western bird guide. 316 p. Doubleday and Company, Inc., Garden City, New York.

ower, Harry W. III.
1966. Biology of the mountain bluebird in Montana. Condor 68(4):351-371.

obbins, Chandler S., Bertel Bruun, and Herbert S. Zim.
1966. Birds of North America. 340 p. Golden Press, New York.

ook, Roland S., and P. H. Baldwin.
1970. Woodpecker predation on bark beetles in Engelmann spruce logs as related to stand density. Can. Entomol. 102(11):1345-1354.

ith, Dwight G., C. R. Wilson, and Herbert H. Frost.
1972. The biology of the American kestrel in central Utah. Southwest. Nat. 17(1):73-83.

lford, Allan D., and G. G. Herman.
1963. Chickadee helps check insect invasion. Audubon Mag. 65(2):78-81.

ager, Lee E.
1955. Two woodpecker populations in relation to environmental change. Condor 57(3):148-153.

leny, Lawrence.
1972. Can we save the bluebird? Living Wilderness 36(119): 24-31.

Appendix I: Plant Species Referred to in Tex

Common Name	Scientific Name
Alder, black	*Alnus* sp.
Almonds	*Prunus* sp.
Apples	*Malus* sp.
Ash	*Fraxinus* sp.
Aspen	*Populus* sp.
Aspen, quaking	*Populus tremuloides* Michx.
Bayberries	*Myrica* sp.
Beechnut	*Fagus grandifolia* Ehrh.
Birch	*Betula* sp.
Blackberries	*Rubus* sp.
Black cherry	*Prunus serotina* Ehrh.
Blueberries	*Vaccinium* sp.
Butternut	*Juglans cinerea* L.
Catalpa	*Catalpa speciosa* Warder
Cedar	*Juniperus* sp.
Cherries	*Prunus* sp.
Chokecherry	*Prunus virginiana* L.
Cissus	*Cissus trifoliata* L.
Corn	*Zea mays*
Cottonwood	*Populus* sp.
Currants	*Ribes* sp.
Dogwood	*Cornus* sp.
Douglas fir	*Pseudotsuga menziesii* (Mirb.) Franco
Elderberries	*Sambucus* sp.
Elm	*Ulmus* sp.
Fir	*Abies* sp.
Fir, red	*Abies magnifica* A. Murr.
Fir, subalpine	*Abies lasiocarpa* (Hook.) Nutt.
Fir, white	*Abies concolor* (Gord. & Glend.) Lindl.
Grapes, wild	*Vitis* sp.
Hackberry	*Celtis* sp.
Hazelnuts	*Corylus* sp.
Hickory nuts	*Carya* sp.
Huckleberries	*Gaylussacia* sp.
Juniper	*Juniperus* sp.
Juniper, alligator	*Juniperus deppeana* Steud.
Juniper, one-seed	*Juniperus monosperma* (Engelm.) Sarg.
Juniper, Rocky Mt.	*Juniperus scopulorum* Sarg.
Juniper, Utah	*Juniperus osteosperma* (Torr.) Little
Larch	*Larix* sp.
Maize	*Sorghum vulgare* Pers.
Maple	*Acer* sp.
Mescal	*Agave* sp.
Mesquite	*Prosopis* sp.
Mistletoe	*Phoradendron* sp.

ommon Name	Scientific Name
ulberries	*Morus* sp.
ak	*Quercus* sp.
ak, Arizona white	*Quercus arizonica* Sarg.
ak, emory	*Quercus emoryi* Torr.
ak, gray	*Quercus grisea* Liebm.
ak, Mexican blue	*Quercus oblongifolia* Torr.
ears	*Pyrus* sp.
ecans	*Carya* sp.
ine	*Pinus* sp.
ine, limber	*Pinus flexilis* James
ine, pinyon	*Pinus edulis* Engelm.
ne, ponderosa	*Pinus ponderosa* Laws.
oison ivy	*Toxicodendron radicans* Kuntze
oison oak	*Toxicodendron quercifolium* (Michx.) Greene
omegranate	*Punica granatum* L.
oplar	*Liriodendron tulipifera* L.
unes	*Prunus* sp.
uinces	*Cydonia* sp.
aspberries	*Rubus* sp.
ed peppers	*Piper* sp.
guaro cactus	*Carnegiea gigantea* (Engelm.) Britt. & Rose
lmonberry	*Rubus spectabilis* Pursh.
rviceberries	*Amelanchier* sp.
ruce	*Picea* sp.
ruce, Engelmann	*Picea engelmanni* Parry
rawberries	*Fragaria* sp.
mac	*Rhus* sp.
nflowers	*Helianthus* sp.
camore	*Platanus* sp.
rginia creeper	*Parthenocissus quinquefolia* L.
alnuts	*Juglans* sp.
illow	*Salix* sp.

Appendix II: Mammals and Reptiles Referred to in Text

Common Name	Order	Family	Genus and Species
Bats	Chiroptera		
Chipmunks	Rodentia	Sciuridae	
Flying squirrels	Rodentia	Sciuridae	*Glaucomys volans* (Linnaeus)
Frogs	Class Amphibia		
Lizards	Gekkonidae		
Moles	Insectivora	Talpidae	
Mice	Rodentia	Cricetidae	
Rats	Rodentia		
Red squirrels	Rodentia	Sciuridae	*Tamiasciurus* sp.
Shrews	Insectivora	Soricidae	
Toads	Class Amphibia		

Appendix III:
Insects and Other Invertebrates Referred to in Text

ommon ame	Class or Order	Family	Genus and Species
ngleworms	Class Oligochaeta		
nts	Hymenoptera	Formicidae	
phids	Homoptera	Aphididae	
ssassin bugs	Hemiptera	Reduviidae	
lack cricket	Orthoptera	Gryllidae	
ees	Hymenoptera	Apidae	
eetles	Coleoptera		
ugs	Hemiptera		
utterflies	Lepidoptera		
aterpillars	Lepidoptera		
entipedes	Class Chilopoda		
icadas	Homoptera	Cicadidae	
lover weevil	Coleoptera	Curculionidae	
odling moth	Lepidoptera	Olethreutidae	*Carpocapsa pomonella* Linn.
ottonboll weevil	Lepidoptera	Gelechiidae	
rawfish	Class Crustacea		
rickets	Orthoptera	Gryllidae	
urculios	Coleoptera	Curculionidae	*Curculio* sp.
utworms	Lepidoptera	Noctuidae	
addy longlegs	Phalangida		
ragon flies	Odonata		
ung beetles	Coleoptera	Scarabaeidae	
rthworms	Class Oligochaeta		
graver beetles	Coleoptera	Scolytidae	
atbugs	Hemiptera	Aradidae	
atheaded wood borers	Coleoptera	Buprestidae	
ies	Diptera		
ying ants	Hymenoptera	Formicidae	
asshoppers	Orthoptera	Acrididae	
ound beetles	Coleoptera	Carabidae	
iry caterpillars	Lepidoptera		
wk moth	Tepidoptera	Sphingidae	
llgrammites	Neuroptera	Corydelidae	
use flies	Diptera	Muscidae	*Musca domestica* L.
sects	Class Insecta		
sids	Homoptera	Cicadellidae	
mping plant lice	Homoptera	Psyllidae	
ne beetles	Coleoptera	Scarabaeidae	
tydids	Orthoptera	Tettigoniidae	

Common Name	**Class or Order**	**Family**	**Genus and Species**
Leaf beetles	Coleoptera	Chrysomelidae	
Leafhoppers	Homoptera	Cicadelliadae	
Leaf skeletonizers	Lepidoptera	Lyonetiidae	*Bucculatrix* sp.
Locusts	Orthoptera	Acrididae	
Locust seed weevils	Coleoptera	Mylabridae	*Bruchus* sp.
Lodgepole needle miner	Lepidoptera	Gelechiidae	*Coleotechnites*
Long-legged tipulids	Diptera	Tipulidae	
May beetles	Coleoptera	Scarabaeidae	
Mayflies	Ephemeroptera		
Millipedes	Class Diplopoda		
Mosquitoes	Diptera	Culicidae	
Moths	Lepidoptera		
Myriapods	Classes Diplopoda & Chilopoda		
Negro bugs	Hemiptera	Corimelaenidae	
Noctuid moths	Lepidoptera	Noctuidae	
Nut weevils	Coleoptera	Curculionidae	
Praying mantids	Orthoptera	Mantidae	
Pseudoscorpions	Pseudoscorpionida		
Psyllids	Homoptera	Psylliidae	
Ribbed pine borer	Coleoptera	Cerambycidae	*Stenocorus inquisitor* (Oliv.)
Round-headed woodborer	Coleoptera	Cerambycidae	
Sawflies	Hemenoptera	Tenthredinidae	
Scale insects	Homoptera	Coccidae	
Scorpions	Scorpionida		
Snails	Class gastropoda		
Spiders	Araneida		
Spruce bark beetle	Coleoptera	Scolytidae	*Dendroctonus* s
Stag-beetle	Coleoptera	Lucanidae	
Stinkbugs	Hemiptera	Pentatomidae	
Termites	Isoptera		
Towbugs	Hemiptera		
Treehoppers	Homoptera	Membracidae	
Wasps	Hymenoptera	Vespidae	
Weevils	Coleoptera	Curculionidae	

Observations

Observations

USDA Forest Service
General Technical Report RM-11
Rocky Mountain Forest and
Range Experiment Station
Forest Service
U.S. Department of Agriculture
Fort Collins, Colorado 80521

Silviculturist's Point of View on Use of Nonlocal Trees

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Gilbert H. Schubert

June 1975

Abstract

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1975. Silviculturist's point of view on use of nonlocal trees. USDA For. Serv. Gen. Tech. Rep. RM-11, 12 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521

Describes important factors that affect the health and vigor of forest trees introduced into communities and high density recreation areas. Seed origin, climatic and edaphic factors, and mycorrhizae are discussed first followed by insects, diseases, animal damage, and species selection. Relevant literature is covered along with observations and experience. Treatise is intended to point out the critical considerations in use of nonlocal trees and to serve as a reference guide in making wise species selection.

Keywords: Recreation area planting, seed origin, urban trees.

USDA Forest Service
General Technical Report RM-11

June 1975

Silviculturist's Point of View On Use of Nonlocal Trees[1]

Gilbert H. Schubert, Principal Silviculturist
Rocky Mountain Forest and Range Experiment Station[2]

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[1] *Presented at "Symposium on Silviculture for Improving Environmental Quality in Communities and High Density Recreation Areas," Logan, Utah, October 9-11, 1973.*

[2] *Central headquarters maintained at Fort Collins, in cooperation with Colorado State University; Schubert is assigned to the Station's Research Work Unit at Flagstaff, in cooperation with Northern Arizona University.*

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Silviculturist's Point of View On Use of Nonlocal Trees

Gilbert H. Schubert

Introduced trees have enriched the environmental quality of communities, recreation areas, and road right-of-ways throughout the world. On wooded areas, man had to cut down trees that occupied the space he needed to build his home, campsite, or road. On barren areas, man went out to find a tree to provide shade and beauty.

Man has not always been fully satisfied with the native trees surrounding his urban house, if indeed there were any. His favorite tree from "back home" was missing. If he moved into an established community, he "hot-footed" it down to the local nursery. Nearly all progressive communities have a nursery or two, but not always his favorite tree. So he either bought a substitute, usually a nonlocal species, or he got out his mail order catalog and ordered a nonlocal tree.

This form of introduction has been going on continuously, though not always successfully. We have introduced nonlocal trees into almost every section of the United States. Areas such as the Great Plains perhaps have more exotic trees than indigenous ones.

Some of the mistakes made in introduction of nonlocal trees have been costly. Some trees such as Ailanthus or Tree-of-Heaven, imported from China, have become a nuisance in many areas, and are difficult to control. We have also introduced the chestnut blight from Asia, and the white pine blister rust and the Dutch elm disease from Europe.

We have even helped to shift around our own native diseases. In 1963, the Southwest was importing western gall rust on ponderosa pine trees raised at a nursery in Oregon. We already had the disease, but we helped spread it to new areas in our reforestation program. A highly destructive virus disease known as phloem necrosis has been shifted around with the American elm. Many of our Siberian elms in Flagstaff, Arizona, have a pit canker. Pole blight is serious in western white pine stands of Idaho, Montana, and Washington.

We often lose ornamental trees in communities and recreation areas. These trees take a lot of punishment each year. A new pavement job may cause an earlier-than-expected death with no apparent trace of causal agent. All sorts of pipelines border some streets. A leaky gas main has been known to cause trees to die. Insects also take their toll.

I am frequently consulted by owners of these sick trees. As a silviculturist, I may be no authority on ornamentals, but since we are addressing ourselves to forest trees used as ornamentals, we might examine some of the problems we face with nonlocal trees, some of the constraints in their use, and some suggestions on what might be done.

Seed Origin

We know that forest tree species occur over a wide range of climatic and physiographic conditions. The geneticists indicate that thousands of possible genotypes are represented in seed crops collected from wild stands (fig. 1). These stands have probably maintained a broad range of genetic variability, even in local races. In fact every seed has a unique genotype. The trees growing in a particular environmental niche represent the progeny of a small proportion of each seed crop. Those genotypes that were adapted to specific conditions survived, while others failed.

Figure 1.—Each seed has a unique genotype with thousands of possible genotypes represented in seed crops of forest stands.

Numerous studies have demonstrated the great racial variability in wide-ranging species. Ponderosa pine has been studied in many regions, usually involving collections from a wide distribution of seed sources (Squillace and Silen 1962, Larson 1966, Shearer 1966, Silen 1970, Steinhoff 1970). Douglas-fir has also been widely studied for many years (Silen 1966, Wright et al. 1970, Wright et al. 1971a). Other species that have been investigated include: lodgepole pine, western white pine, southwestern white pine, limber pine, Monterey pine, Scotch pine, red pine, white fir, blue spruce, Siberian larch, and Dahurian larch.

Exhaustive studies have also been made at single locations involving many species. The most noteworthy are the tests at the Eddy Arboretum at Placerville, California, and the Wind River Arboretum near Carson, Washington. At the Eddy Arboretum, 72 species, 35 varieties, and 90 hybrids of pine have been investigated (Liddicott and Righter 1960). The arboretum contains over 50 other species. At the Wind River Arboretum, over 400 seed lots of various species that might be suitable for planting in the Pacific Northwest have been under investigation, many dating back to 1912 (Silen and Woike 1959).

What does this all prove? The various studies have demonstrated significant differences in survival, growth, tree form, foliage color, and other characteristics. Many studies showed differences in growth of progeny from collection areas just a few miles apart. Based on studies conducted in the Great Plains, a better Douglas-fir Christmas tree and ornamental has been developed for planting in the eastern United States (Wright et al. 1970). Douglas-fir seed from near Cloudcroft, New Mexico, has been far superior to any other seed sources, even those just a few miles away, in progeny tests in Germany.[3] Young trees from sources near Cloudcroft were twice as tall as the nearest rival and had better form and color. Research in the Great Plains has provided Nebraska with an outstanding Christmas tree and ornamental, southwestern white pine (Wright et al. 1971b), which in its native habitat on the Mogollon Plateau in Arizona has little value.

Nearly all of the species tested at the Wind River Arboretum have failed to measure up to Douglas-fir for timber production, although many are suitable as ornamentals (Silen and Woike 1959).

What have we learned from these racial variation studies? Other than the good things referred to above, we have discovered that it is often difficult to beat the indigenous species. Goor (1963) pointed out that indigenous trees, when properly planted, were the best assurance of success in afforestation. Introduction of exotics should be tried, but with proper judgment. The species chosen, whether it is introduced from another country or merely moved within the same country, should fulfill a definite need (Champion and Brasnett 1958).

The necessity of matching climates has been stressed by all who have studied the racial variation in species, especially those with extensive ranges. In the Southwest, we have divided up the forested areas of Arizona and New Mexico into 10 physiographic-climatic regions

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[3] *Personal communication from Dr. Walter Neugebauer, Pein and Pein Nursery near Hamburg, Germany.*

(fig. 2) (Schubert and Pitcher 1973). These regions were then subdivided into five to nine collection zones about 50 miles wide. Tentative ecological provinces have been defined for the true fir-hemlock forests of the Pacific Northwest (Franklin 1965). Similar seed provenance units have been established in other regions.

The question "How local is local?" has been often raised. Silen (1970) says it may be as small as the immediate area beneath the seed tree or it may be several miles. At Priest River, Idaho—where 27 races of ponderosa pine have been growing for 55 years—survival is poor for trees from seed sources more than 200 miles away (Steinhoff 1970). Ponderosa pines from a western Montana source all died when planted in eastern Montana, while those planted in western Montana had excellent survival (Shearer 1966). Siberian and Dahurian larches showed significant survival differences from narrowly separated origins (Cunningham 1972). On the other hand, however, many exotics from Europe and Asia have survived well at both the Eddy Arboretum (Liddicott and Righter 1960) and at the Wind River Arboretum (Silen and Woike 1959). Special care should be exercised with species of wide, and particularly with discontinuous, distribution; the geographical races

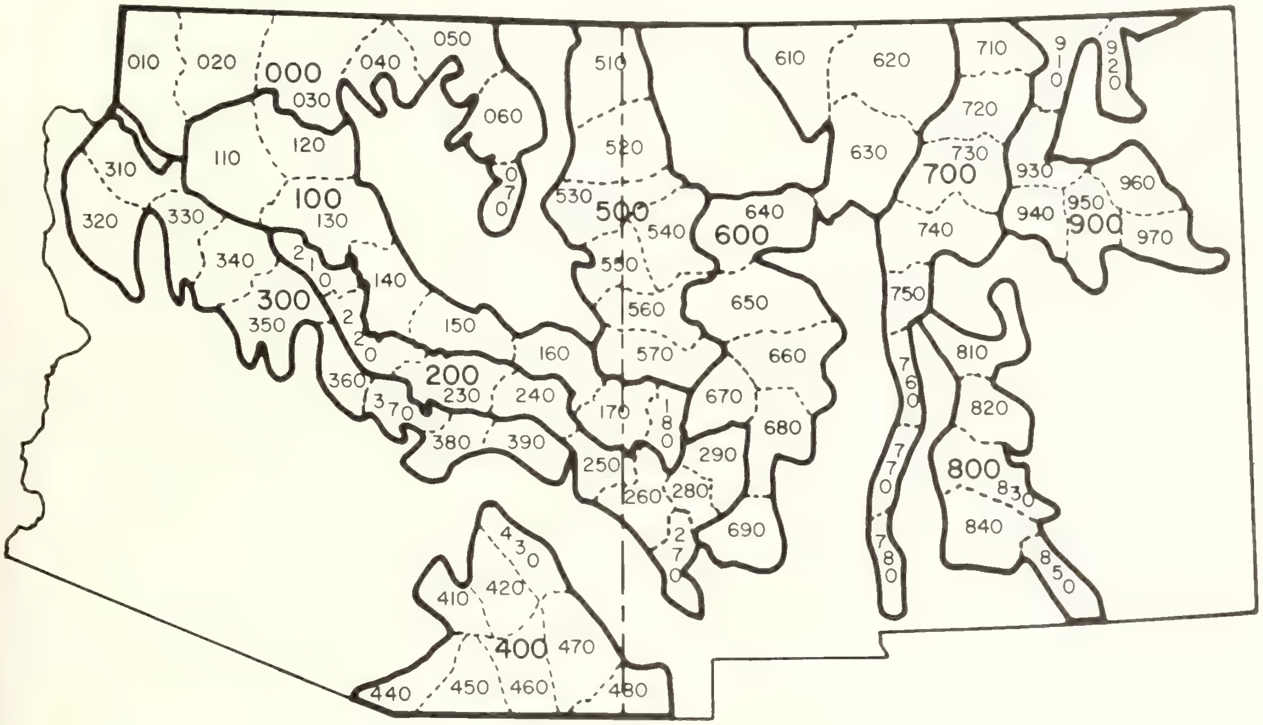

Figure 2.—Physiographic-climatic zones defined for the Southwest Region to match areas of similar environmental conditions (Schubert and Pitcher 1973):

000 Northwest Plateaus (Seed Zones 010-070)
100 Central Plateaus (Seed Zones 110-180)
200 Mogollon Slope and Highlands (Seed Zones 210-290)
300 Central Highlands (Seed Zones 310-390)
400 Southeast Desert Highlands (Seed Zones 410-480)
500 Chuska-Zuni-Gallo Highlands (Seed Zones 510-570)
600 East Continental Highlands (Seed Zones 610-690)
700 East Rio Grande Highlands (Seed Zones 710-780)
800 Sacramento-Guadalupe Range (Seed Zones 810-850)
900 Northeast Plains (Seed Zones 910-970)

and ecotypes within them may vary widely in performance in a new site (Champion and Brasnett 1958).

Climatic Factors

Climatic extremes have been the major cause of mortality. Frequently, when trees are planted in sheltered spots, climatic extremes of the areas that could cause damage are abated (Silen 1966). Extreme low temperatures seem to be the most limiting factor, though extreme droughts have also been responsible for high mortality (Champion and Brasnett 1958).

Temperature

According to Good (1953), "There are no parts of the world where the temperatures are too high for growth and reproduction," so the limiting factor would be low temperature. Therefore, lowest recorded temperatures for the area should be determined before selecting planting stock. Low temperature eliminated all the west-slope Sierra Nevada sources from California that were planted at Fort Valley Experimental Forest near Flagstaff, Arizona (Larson 1966). Monterey pines planted in Oregon (Krygier 1958) and in the Sierra Nevada of California (Schubert and Adams 1971) were killed by low temperatures. Low temperatures have prevented the extension of redwood to the north (Mason 1936), and caused considerable damage to exotics in the Wind River Arboretum (Silen and Woike 1959).

Planted sugar pines in the Sierra Nevada of California were found to be more affected by a sudden drop in temperature than were incense-cedars or ponderosa pine (Schubert 1955). In the Inland Empire, progenies from localities with a wide range in temperature were most resistant to frost damage (Squillace and Silen 1962).

Long-term studies are needed to establish the low temperature threshold (Silen 1970). Near San Francisco, from 3 to 4 million nonnative eucalyptus trees, planted near the turn of the century, were killed or severely damaged by cold in 1972. Nearly all nonlocal trees planted in an arboretum at Chico, California, were wiped out by the 1932 freeze after the trees had made good growth for over 20 years.[4] None of the native trees were damaged.

Native trees are also susceptible to extreme temperature, but seldom are killed (Parker 1953, Duffield 1956,). Severe topkill of native Coulter pines and bigcone Douglas-fir has occurred in southern California (Wagener 1949). Ponderosa pine ecotypes east of the Cascades in Washington and Northern Idaho appear to be more resistant to severe winter temperatures than those on the west side of the Cascades in Washington (Daubenmire 1957).

Trees from high-elevation sources, when planted at lower elevations, burst buds earlier than in the native site and often suffer severe damage by a late freeze (Goor 1963, Silen 1970). These same low temperatures may damage individual trees in local populations, but the damage is usually less severe than that suffered by offsite trees.

Snow and Ice

Snow and ice also cause severe damage to offsite trees. Siberian elms in Flagstaff, Arizona, have suffered severe breakage by heavy wet snows. Larches in the Wind River Arboretum have suffered considerable breakage (Silen and Woike 1959). Snow breakage in pole-sized ponderosa pine has been more severe in stands of high density than in low (Powers and Oliver 1970). Snowbending of sugar pine and ponderosa pine seedlings was found to be a temporary injury unless too severely bent or broken (fig. 3) (Schubert and Adams 1971). Ice has caused considerable damage in some areas, especially to trees from warmer seed sources (Jones and Wells 1969).

From these observations, we can avoid some of the low temperature, ice, and snow damage by selecting species that have demonstrated resistance. Much, but not all, damage can be avoided by selecting trees from areas having a similar climate.

Drought

Forest types are to a great extent determined by the amount of precipitation (Pearson 1931, Champion and Brasnett 1958, Goor 1963). Planted trees, with their reduced root systems, generally suffer considerable damage, particularly where spring precipitation is low and erratic (Schubert et al. 1970, Schubert and Adams 1971). Wildling stock is generally a poor risk (Schubert and Adams 1971), but many people still dig up seedlings from the forest for planting in their yards. The failure of the ponderosa pine from western Montana planted in eastern

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[4] *Personal communication from Woodbridge Metcalf (deceased), former Extension Forester, School of Forestry, University of California, Berkeley.*

Montana was reported to be due to drought (Shearer 1966). Severe drought damage has occurred at the Wind River Arboretum (Silen and Woike 1959).

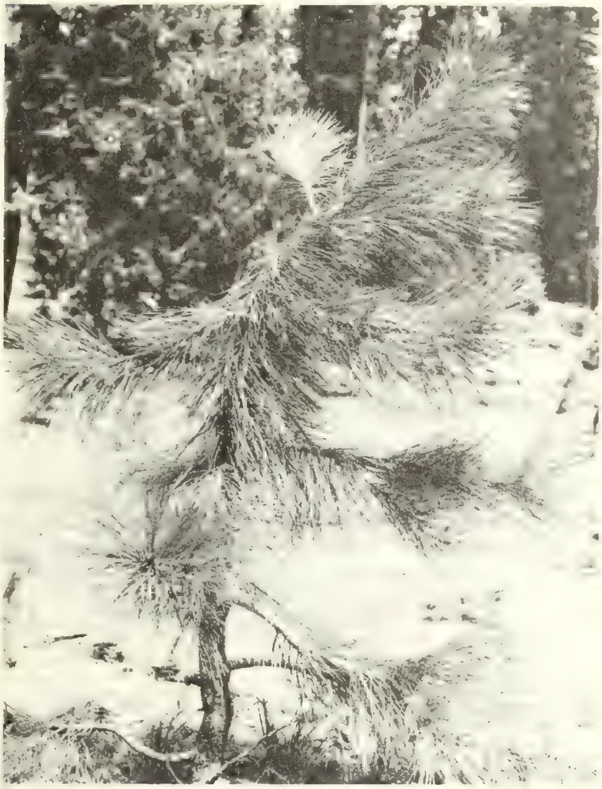

Figure 3.—Young ponderosa pines bent by heavy wet snow during early spring usually recover unless the trees are severely bent or broken.

Ponderosa pine is known to be quite drought resistant (Pearson 1931). Trees with reported drought resistance include: Tree-of-Heaven, green ash, velvet ash, boxelder, northern catalpa, Siberian elm, common hackberry, black locust, Russian mulberry, Russian-olive, tamarisk, bur oak, sugarberry, honeylocust, eastern redcedar, white fir, and the spruces (Gill 1949, Wright and Bretz 1949).

Drought is normally not a problem in urban plantings. The critical period in survival of planted trees is during the first couple of years. Trees that come from areas where summer rains are normal should be watered when planted on droughty sites. Water stresses may be reduced by removal of competing vegetation and by mulching (Schubert et al. 1970, Schubert and Adams 1971).

Soil Factors

The soil requirements for optimum development and the range of conditions tolerated vary greatly for different tree species, and are second only to climatic factors in determining natural distribution and wise selection for planting (Lutz and Chandler 1947, Champion and Brasnett 1958, Goor 1963). In relatively small regions of uniform climate, the nature of the parent material is probably more important than any other single factor in determining the character and productivity of soils (Lutz and Chandler 1947). In the Black Hills, soil depth was found to have a stronger influence on site productivity than parent material although soil depth is often related to parent material (Myers and Van Deusen 1960). In Montana, ponderosa pine growth response was related to soil type, effective soil depth, landform, and moisture availability (Cox et al. 1960). On selected sites in Arizona, Colorado, Idaho, and Utah, water-holding capacities of the soil varied from 25.8 to 70.0 percent, and wilting coefficients from 3.3 to 16.1 percent.

Soils have a significant influence on the type of forest they support (Pearson 1931, Lutz and Chandler 1947). In the Southwest, about half of the ponderosa pine sawtimber occurs on soils derived from basaltic rocks, and planted trees readily become established (Pearson 1931). Ponderosa pine has been most productive on Permean limestones, intermediate on calcareous sandstone, and least on siliceous sandstone and cinders. Rocky Mountain juniper occurs more abundantly on limestone than sandstone where both are present (Lutz and Chandler 1947). Northern white-cedar was found to occur most abundantly on calcareous soils, whereas jack pine was most abundant on acid soils (Fernald 1919).

Survival of spring-planted trees was highest on heavier soils in the northern Rockies, whereas survival of fall-planted trees was highest on light- and medium-textured soils (LeBarron et al. 1938). In Montana, ponderosa pine stands were found to have their best root development in medium-textured soils and poorest in fine-textured soils (Cox 1959). Root concentration was more uniform in medium-textured soils and decreased abruptly below 18 inches in fine-textured soils. Lodgepole pine takes over the site from ponderosa pine in areas having a tight clay subsoil that prevents good drainage (Howell 1931). Windthrow is a problem on many of the areas with a clay hardpan near the surface.

Alkali soils are a problem in some areas of the Great Plains and northern Rocky Mountains. Some of the species that can tolerate and grow on alkali soils include: common hackberry, Russian-olive, velvet ash, Norway maple, tamarisk, and eucalyptus (Gill 1949, Wright and Bretz 1949). Soil alkalinity is one of the limiting factors in establishment of oak.

Fortunately, alkali soils are not too widespread. Some corrective action to reduce the adverse effect of alkali include: Leaching with underdrainage, removal of the alkali incrustations, and treating with gypsum or sulfur (Lutz and Chandler 1947). Areas treated with gypsum or sulfur must be kept moist for the reaction to take place. Trees with deep rooting characteristics are most suitable for planting in alkali soils. Tree establishment may be improved by digging considerably larger holes than is used in ordinary planting and replacing the alkali soil with good rich sandy loam.

Most adverse soil conditions can be at least partly corrected for community or recreation-area tree planting. Some corrective treatments may be expensive, but the total job is rather small. Relatively few trees are planted in urban areas compared to forest plantations. On difficult problem soils, an expert soil scientist should be consulted.

Mycorrhizae

Good development of mycorrhizae on roots of forest trees has generally been accepted as necessary for good survival and growth (fig. 4). Monterey pine planting stock from new nurseries in western Australia was satisfactory only when seedbeds were inoculated with soil taken from old pine nurseries (Cromer 1935). This practice is not always recommended, however, as it may result in the introduction of serious pathogens. A preferable source would be a healthy plantation or native forest. Furthermore, fumigants used in nurseries to destroy harmful fungi also kill mycorrhizal fungi (Wright 1957).

Many plantation failures have been due to the absence of mycorrhizae. Many failures listed as due to "unknown" causes may also have been due to the absence of mycorrhizae. A possible example is the rapid and complete failure of Monterey pine planted on 5,000 acres of newly cleared land in Florida (Schaer 1959). In the Southeast, mycorrhizae were reported to be vital for survival of slash pine (Jorgensen and Shoulders 1967) and loblolly pine (Shoulders and Jorgensen 1969).

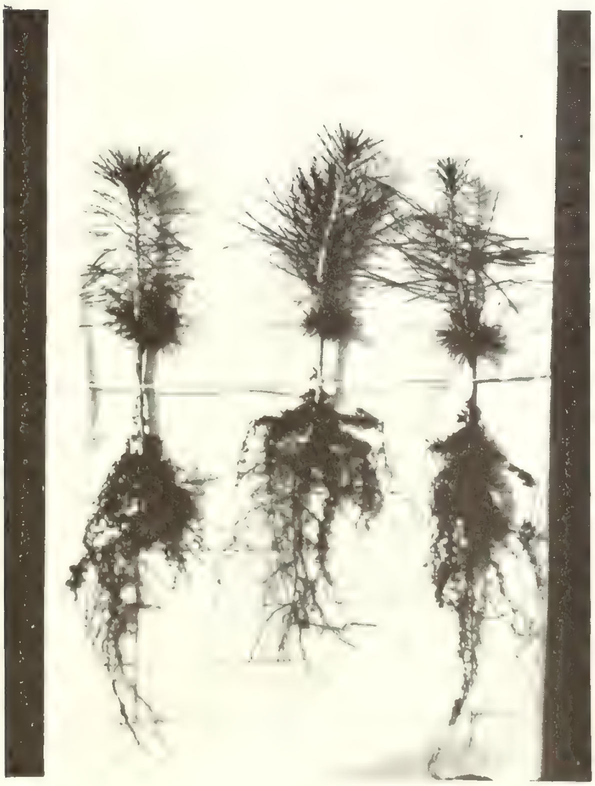

Figure 4.—Mycorrhizal fungi on roots of forest trees are necessary for good survival and growth in afforestation.

Mycorrhizal mycelia are probably more effective than root hairs in reestablishing early contact with the soil (Smith 1962), are important in soils low in available nutrients (Wright 1957), and protect the plant from pathogenic fungi (Cromer 1935).

Plantings on areas which have never been forested or which have remained without a forest cover for a number of years have been particularly difficult to plant successfully (Schubert et al. 1970, Schubert and Adams 1971). Sometimes phenomenal success follows mycorrhizal inoculation. In Puerto Rico, attempts to establish *Pinus caribaea* failed repeatedly until someone placed forest soil rich in mycorrhizae around 3 of the 5,000 planted trees.[5] The three inoculated trees were 24 to 30 feet high in 5 years, whereas most of the others were dead or severely stunted.

Mycorrhizae have been reported on 56 conifer and 73 broadleaf species (Trappe 1964).

The lessons to be learned from these experiences are quite obvious, yet we continue to grow and plant trees without mycorrhizal roots. Much of the containerized stock produced for planting is grown in sterile media. When planted on old burns or clearcuts, these trees may fail to survive due to "unknown causes."

Insects

Insects are present everywhere, but not all are harmful. At the Wind River Arboretum, insects were reported to be a problem on individual trees, but did not cause the failure of any species (Silen and Woike 1959). The possibility of severe damage is ever present, particularly in introduced species or under intensive cultural practices.

Insect damage in recreation areas and communities is particulary serious due to the high esthetic value attached to each tree (fig. 5). Green ash, which is widely planted as an ornamental and for windbreaks, has been attacked by various species of wood borers (McKnight and Tunnock 1973). The likelihood of borer damage is so great that it limits the use of green ash in parts of North Dakota, South Dakota, and Montana. These native borers have become more abundant as the supply of host material increased.

The western spruce budworm causes more damage on western larch than normally occurs on other conifers (Schmidt and Fellin 1973). The larvae normally confine their feeding to foliage, but on western larch they also feed on and sever stems of current-year terminals and lateral shoots. Both the amount and severity of damage is reported to be increasing annually.

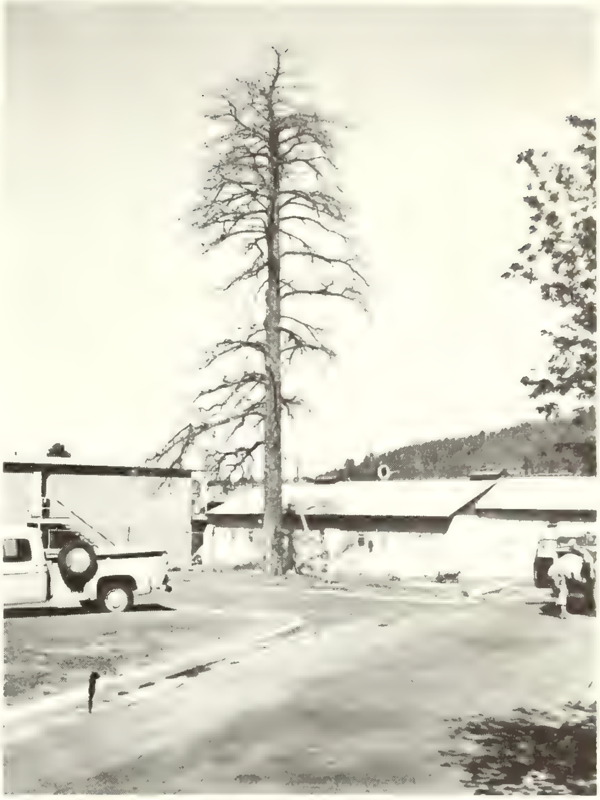

Figure 5.—Bark beetles cause considerable damage to trees in concert with other factors such as street paving and building construction.

The carpenterworm has attacked many introduced trees in the Plains and northern Rocky Mountains. It has damaged green ash, Russian-olive, honeylocust, black walnut, black locust, poplar, cottonwood, willow, elms, soft maple, pear, cherry, and lilac.

Early detection and treatment are necessary to keep these and other insects under control. Since control methods vary, it is advisable to seek advice from an expert entomologist.

Diseases

Many native diseases take a heavy toll of our forest trees each year. Over the years, we have imported a few which have caused extensive damage. The chestnut blight, Dutch elm disease, and white pine blister rust have received the greatest attention. The chestnut blight has essentially eliminated the American chestnut, except possibly for a few escapees. The white pine blister rust is a threat to all white pine, native or exotic. The Dutch elm disease is on the move westward, and has reached the foothills of the Rockies in Colorado.

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[5] *Based on comments by James Trappe at the "Artificial Forest Regeneration Workshop" held at Ogden, Utah, September 7-8, 1964.*

Fomes root rot is found worldwide. *Fomes annosus* is one of the most serious pathogens of conifers in the temperate climatic zone. Systematic disease surveys in California during the past two decades suggest that *Fomes annosus* root rot is becoming increasingly significant as a limiting factor in the intensive management of conifer plantations (Bega and Smith 1966). In young pine plantations, the disease invades and kills the root cambium rapidly and the tree dies. In the true fir and other non-pine species, death of the tree is considerably slower. Trees should not be planted within the root zone of a tree suspected of having *Fomes annosus* root rot.

Dwarf mistletoes are widely recognized as damaging agents to shade trees, horticultural plants, and forest trees. Mistletoes cause reduced vigor and growth, poor fruit or seed crops, malformation of woody tissues, sparse foliage, dead tops, predisposition to insect and other disease attacks, and premature death of the host tree.

Many species are infected by mistletoes. A survey in western Montana indicated that dwarf mistletoe was present on 23 percent of the 3.4 million acres of commercial timberland (Graham 1964). Heavy infections were reported in Douglas-fir and western larch stands in northeastern Washington (Graham and Frazier 1962). Brewer spruce has been severely infected by fir, sugar pine, and hemlock dwarf mistletoes (Hawksworth et al. 1970).

Dwarf mistletoe causes more damage to ponderosa pine than any other disease (Kimmey and Mielke 1959). Lodgepole pine dwarf mistletoe was found to be more common on ponderosa pine than previous reports indicated, and occurs frequently outside the range of ponderosa pine dwarf mistletoe (Hawksworth 1968a). Ponderosa pine dwarf mistletoe frequency is highest on gentle slopes and lowest on steep slopes (Hawksworth 1968b). This places it down among communities and recreational areas.

Nonlocal stock may be more seriously affected than the native trees. Much of the poor success of exotics has been attributed to disease. Nonlocal trees may be very susceptible to native diseases, but susceptibility has been reported to vary by seed origin (Peterson and Read 1971).

We can do much to reduce damage and prevent losses. Many diseases are brought in on the planting stock. A safer way is to bring in nonlocal trees by seed. Trees known or suspected to be susceptible to native diseases should not be planted in the diseased areas. Trees planted in communities and other heavy-use areas receive more abuse than those in a forest. Proper treatment, care, and protection are therefore essential to their continued health and vigor. Too much "good treatment" may not be wise, however. For example, Russian-olive requires little water, and if watered too much may die from a root disease that thrives only in continuously moist situations.[6]

Animal Damage

Many tree species appear to be favorite food for certain animals (Schubert et al. 1970, Schubert and Adams 1971). Livestock normally are no problem in communities, but may at times invade recreation areas. Big-game animals relish many broadleaf species and some conifers. At the new Fort Valley Arboretum near Flagstaff, Arizona, elk browsed all the new growth of the oak, maples, elms, and other hardwoods that had been planted earlier in the spring.[7] It was enjoyable to watch the elk gracefully leap over the fence, but then after the damage was noticed the enjoyment faded rapidly.

Some animals show preference (fig. 6). In the above example, elk liked the hardwoods better than the conifers. The Abert squirrel in northern Arizona gets about 95 percent of his food from ponderosa pine (Schubert and Adams 1971). In a hybrid plantation in California, porcupines killed from 2 to 37 percent of the ponderosa pine hybrids, with only minor damage to Jeffrey pine (Schubert and Adams 1971). The black-tailed jackrabbit browsed the ponderosa pine from sources west of the Continental Divide more heavily than the sources from the east (Read 1971). Rabbits, deer, and porcupines have shown different preferences for plants of different sources in the Pacific Northwest (Squillace and Silen 1962).

The high-value trees planted in recreation areas need to be protected from animals until they are out of danger. Young trees should be

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[6] *Personal communication from Paul Lightle, formerly Principal Pathologist with the Rocky Mountain Forest and Range Experiment Station, Albuquerque, New Mexico.*

[7] *Personal communication from Dr. Donald Wommack, Professor of Forestry, Northern Arizona University, Flagstaff, Arizona.*

Figure 6.—Porcupines have shown a decided preference for ponderosa pines of certain genotypes.

surrounded by an appropriate fence, or treated with an animal repellent. Larger trees may require metal bands to prevent climbing by porcupines. In areas with a heavy gopher population, a metal band or fine mesh screen can be used.

Species Selection

Indigenous species would be the most likely to survive and grow, but in some areas the right kind may not be available to meet the desired need. Most communities have a number of species, particularly in parks and on campuses, and may serve as a "local arboretum." These trees could be examined for: their suitability for shade, screen, or esthetics; their resistance to insects and disease; their ability to withstand cold, snow, ice, and wind damage; and their resistance to abuse by man. These "town-trees" may not give a true picture of their cold-hardiness or drought hardiness, however, because of the heat output from houses and the heavy watering.

Lists are available that give characteristics and suitability of tree species for specific areas such as the Plains (Wright and Bretz 1949) and the Rockies (Gill 1949). New trees are continually introduced—not always successful or wise choices—by homeowners or through research. Japanese larch was suggested as a new tree for eastern Nebraska following a 10-year test by research personnel (Read 1970), although we realize the tree may still succumb at a future date due to some extreme weather condition, bug, or disease. These factors often work in concert. Once a tree is weakened by drought, it falls prey to insects or diseases.

Many trees can be used in their youth that do poorly later. A planned rotation will permit use of offsite material that would not be possible otherwise. Where we have an established native tree population that does not meet all the requirements for diversity, we can always resort to: group-selection cutting to create small openings for vertical diversity as new trees become established; variable-density thinning to create horizontal diversity; or underplant with a shade-tolerant species to get species diversity. These methods are commonly used in travel influence zones through forested highways.

Summary

I feel we can solve many of the constraints on the use of nonnative trees in community and recreation areas, provided we:

1. Select a species that is reasonably adapted to the local climatic and edaphic conditions.
2. Select a species that is resistant to native insects and diseases.
3. Plant a tree that is free of insects or diseases so that the native trees are not endangered.
4. Inoculate the soil or tree roots with mycorrhizae free of other pests if the proper mycorrhizae are absent.
5. Prepare the site to eliminate root competition for moisture or correct some undesirable soil condition.
6. Water the plant, if necessary, to give the tree a good start and maintain good vigor in its new environment.
7. Plan to replace nonnative trees at regular intervals that grow well in their youth but lose vigor later.
8. Provide the necessary care and protection the tree needs in its new habitat.

Literature Cited

Bega, Robert V., and Richard S. Smith, Jr.
1966. Distribution of *Fomes annosus* in natural forests of California. Plant Dis. Rep. 50: 832-836.

Champion, Harry, and N.V. Brasnett.
1958. Choice of tree species. FAO For. Dev. Pap. 13, 307 p.

Cox, G.S.
1959. Root distribution in ponderosa pine stands growing on three soils. Montana Acad. Sci. Proc. 19:135-141.

Cox, G.S., R.C. McConnell, and L.M. Mathews.
1960. Ponderosa pine productivity in relation to soil and landform in western Montana. Soil Sci. Soc. Am. Proc. 24:139-142.

Cromer, D.A.N.
1935. The significance of mycorrnizae of *Pinus radiata*. Aust. Commonw. For. Bur. Bull. 16:1-17.

Cunningham, Richard A.
1972. Development of Siberian and Dahurian larches after 10 years in North Dakota. USDA For. Serv. Res. Note RM-209, 4 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Daubenmire, R.F.
1957. Injury to plants from rapidly dropping temperatures in Washington and northern Idaho. J. For. 55:581-585.

Duffield, John W.
1956. Damage to western Washington forests from November 1955 cold wave. U.S. For. Serv., Pac. Northwest For. and Range Exp. Stn. Res. Note 129, 8 p. Portland, Oreg.

Fernald, M.L.
1919. Lithological factors limiting the ranges of *Pinus banksiana* and *Thuja occidentalis*. Rhodora 21:41-67.

Franklin, Jerry F.
1965. Tentative ecological provinces within the true fir-hemlock forest area of the Pacific Northwest. U.S. For. Serv. Res. Pap. PNW-22, 31 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Gill, Lake S.
1949. Shade trees for the Rockies. U.S. Dep. Agric. Yearb. 1949:72-76.

Good, Ronald.
1953. The geography of flowering plants. 2d Ed. 452 p. Longmans, Green and Co., London.

Goor, A.Y.
1963. Tree planting practices for arid zones. FAO For. Dev. Pap. 16, 233 p.

Graham, Donald P.
1964. Dwarfmistletoe survey in western Montana. U.S. For. Serv., Intermt. For. and Range Exp. Stn. Res. Note INT-14 7 p. Ogden, Utah.

Graham, Donald P., and William E. Frazier.
1962. Dwarfmistletoe survey in northeastern Washington. U.S. For. Serv., Intermt. For. and Range Exp. Stn. Res. Note 103, 8 p. Ogden, Utah.

Hawksworth, Frank G.
1968a. Lodgepole pine dwarf mistletoe on ponderosa pine. Plant Dis. Rep. 52:125-127.

Hawksworth, Frank G.
1968b. Ponderosa pine dwarf mistletoe in relation to topography and soils on the Manitou Experimental Forest, Colorado. U.S. For. Serv. Res. Note RM-107, 4 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins.

Hawksworth, Frank G., H.H. Bynum, and Donald V. Hemphill.
1970. Dwarf mistletoes on Brewer spruce. Plant Dis. Rep. 54:485-489.

Howell, Joseph H.
1931. Clay pans in western yellow pine type. J. For. 29:962-963.

Jones, Earle P., and Osborn O. Wells.
1969. Ice damage in a Georgia planting of loblolly pine from different seed sources. U.S. For. Serv. Res. Note SE-126, 4 p. Southeast. For. Exp. Stn., Asheville, N.C.

Jorgensen, J.R., and Eugene Shoulders.
1967. Mycorrhizae development vital to survival of slash pine nursery stock. Tree Planters' Notes 18(2):7-11.

Kimmey, James W., and James L. Mielke.
1959. Western dwarfmistletoe on ponderosa pine. U.S. Dep. Agric., For. Pest Leafl. 40, 7 p.

Krygier, James T.
1958. Survival and growth of thirteen tree species in coastal Oregon. U.S. Dep. Agric., For. Serv., Pac. Northwest For. and Range Exp. Stn. Res. Pap. 26, 20 p. Portland, Oreg.

Larson, M.M.
1966. Racial variation in ponderosa pine at Fort Valley, Arizona. U.S. For. Serv. Res. Note RM-73, 7 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

LeBarron, R.K., Gordon Fox, and R.H. Blythe, Jr.
1938. The effect of season of planting and other factors on early survival of forest plantations. J. For. 36:1211-1215.

Liddicott, A.R., and F.R. Righter.
1960. Trees of the Eddy Arboretum. U.S. For. Serv. Pac. Southwest For. and Range Exp. Stn. Misc. Pap. 43, 41 p. Berkeley, Calif.

Lutz, Harold J., and Robert F. Chandler, Jr.
1947. Forest soils. 2d Print. 514 p. John Wiley & Sons, New York.

Mason, H.L.
1936. The principles of geographic distribution as applied to floral analysis. Madrono 3:181-190.

McKnight, M.E., and Scott Tunnock.
1973. The borer problem in green ash in North Dakota shelterbelts. N.D. Agric. Exp. Stn. Farm Res. 30(5):8-14.

Myers, Clifford A., and James L. Van Deusen.
1960. Site index of ponderosa pine in the Black Hills from soil and topography. J. For. 58:458-555.

Parker, Johnson.
1953. Annual trends and cold hardiness of pondersoa pine and grand firs. Ecology 34:377-380.

Pearson, G.A.
1931. Forest types in the Southwest as determined by climate and soil. U.S. Dep. Agric. Tech. Bull. 247, 144 p.

Peterson, Glenn W., and Ralph A. Read.
1971. Resistance to *Dothistroma pini* within geographic sources of *Pinus nigra*. Phytopathology 61:149-150.

Powers, Robert F., and William A. Oliver.
1970. Snow breakage in a pole-sized ponderosa pine plantation—more damage at high stand densities. USDA For. Serv. Res. Note PSW-218, 3 p. Pac. Southwest For. and Range Exp. Stn., Berkeley, Calif.

Read, Ralph A.
1970. A new tree for eastern Nebraska. Nebr. Agric. Exp. Stn. Q. 17(3):10-11.

Read, Ralph A.
1971. Browsing preference by jackrabbits in a ponderosa pine provenance plantation. USDA For. Serv. Res. Note RM-186, 4 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Schaer, R.L.
1959. Comparison of pine species on Florida sandhills. J. For. 57:416-419.

Schmidt, Wyman C., and David G. Fellin.
1973. Western spruce budworm damage affects form and height growth of western larch. Can. J. For. Res. 3:17-26.

Schubert, Gilbert H.
1955. Freezing injury to young sugar pine. J. For. 53:732.

Schubert, Gilbert H., and Ronald S. Adams.
1971. Reforestation practices for conifers in California. 359. p. Calif. Div. For., Sacramento.

Schubert, Gilbert H., L.J. Heidmann, and M.M. Larson.
1970. Artificial reforestation practices for the Southwest. U.S. Dep. Agric., Agric. Handb. 370, 25 p.

Schubert, Gilbert H., and John A. Pitcher.
1973. A provisional tree seed-zone and cone-crop rating system for Arizona and New Mexico. USDA For. Serv. Res. Pap. RM-105, 8 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Shearer, Raymond C.
1966. Development of ponderosa pine progeny in western Montana. U.S. For. Serv. Res. Note INT-52, 4 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Shoulders, Eugene, and J.R. Jorgensen.
1969. Mycorrhizae increase field survival of planted loblolly pine. Tree Planters' Notes 20(1):14-17.

Silen, Roy R.
1966. A 50-year racial study of Douglas-fir in western Oregon and Washington. West. For. Genet. Assoc. Proc. 1965:6-7.

Silen, Roy R.
1970. The seed source question of ponderosa pine. p. 22-25. *In* Regeneration Ponderosa Pine Symp. [Corvallis, Oreg., Sept. 1969] Proc. Oreg. State Univ.

Silen, Roy R., and Leonard R. Woike.
1959. The River Arboretum. U.S. Dep. Agric., For. Serv., Pac. Northwest For. and Range Exp. Stn. Res. Pap. 33, 50 p. Portland, Oreg.

Smith, David Martyn.
1962. The practice of silviculture. 7th ed. 578 p. John Wiley and Sons, N.Y.

Squillace, A.E., and R.R. Silen.
1962. Racial variation in ponderosa pine. For. Sci. Monogr. 2, 27 p.

Steinhoff, R.J.
1970. Northern Idaho ponderosa pine racial variation study—50-year results. USDA For. Serv. Res. Pap. INT-118, 4 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Trappe, James M.
1964. Mycorrhizae hosts and distribution of *Cenococcum graniforme*. Lloydia 27: 100-106.

Wagener, Willis W.
1949. Top dying of conifers from sudden cold. J. For. 47:49-53.

Wright, E.
1957. Importance of mycorrhizae to ponderosa pine seedlings. For. Sci. 3:275-280.

Wright, Ernest, and T.W. Bretz.
1949. Shade trees for the Plains. U.S. Dep. Agric. Yearb. 1949:65-72.

Wright, J.W., F.H. Kung, R.A. Read, W.A. Lemmien, and J.N. Bright.
1971a. Genetic variation in Rocky Mountain Douglas-fir. Silvae Genet. 20:54-60.

Wright, J.W., F.H. Kung, R.A. Read, R.J. Steinhoff, and J.W. Andresen.
1971b. Nine-year performance of *Pinus flexilis* and *P. strobiformis* progenies in Michigan and Nebraska. Silvae Genet. 20: 211-214.

Wright, J.W., R.A. Read, F.H. Kung, J.N. Bright, and W.A. Lemmien.
1970. Better Douglas-fir for eastern United States. Am. Christmas Tree Growers' J. 14(3):23-28.

Agriculture—CSU, Ft. Collins

Schubert, Gilbert H.
1975. Silviculturist's point of view on use of nonlocal trees. USDA For. Serv. Gen. Tech. Rep. RM-11, 12 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521

Describes important factors that affect the health and vigor of forest trees introduced into communities and high density recreation areas. Seed origin, climatic and edaphic factors, and mycorrhizae are discussed first followed by insects, diseases, animal damage, and species selection. Relevant literature is covered along with observations and experience. Treatise is intended to point out the critical considerations in use of nonlocal trees and to serve as a reference guide in making wise species selection.

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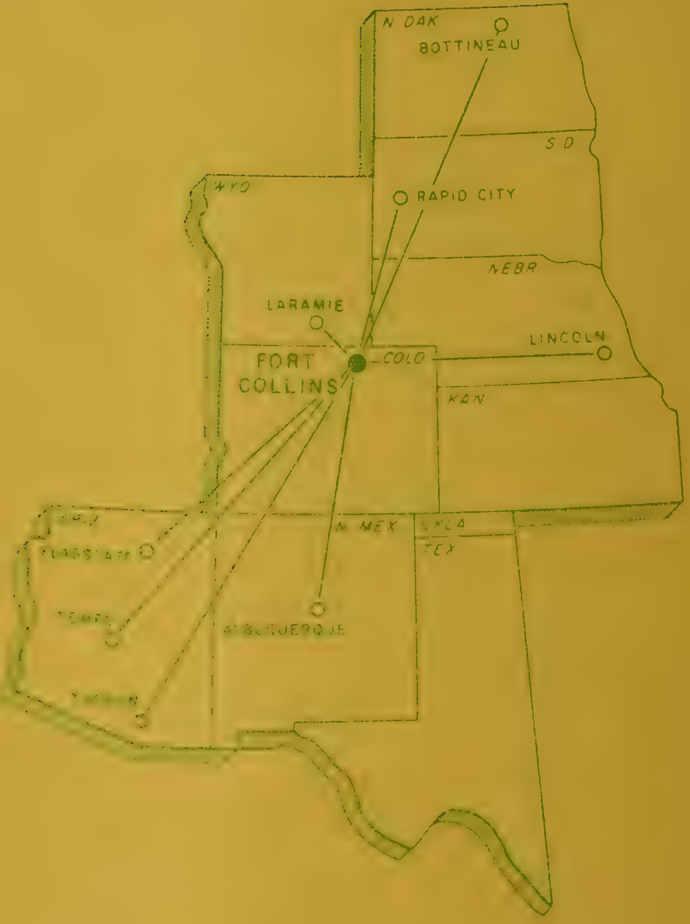
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Forest Habitat Types on the Medicine Bow National Forest, Southeastern Wyoming: Preliminary Report

John M. Wirsing and Robert R. Alexander

USDA Forest Service
General Technical Report RM-12
Rocky Mountain Forest and
Range Experiment Station
Forest Service
U.S. Department of Agriculture
Fort Collins, Colorado 80521

June 1975

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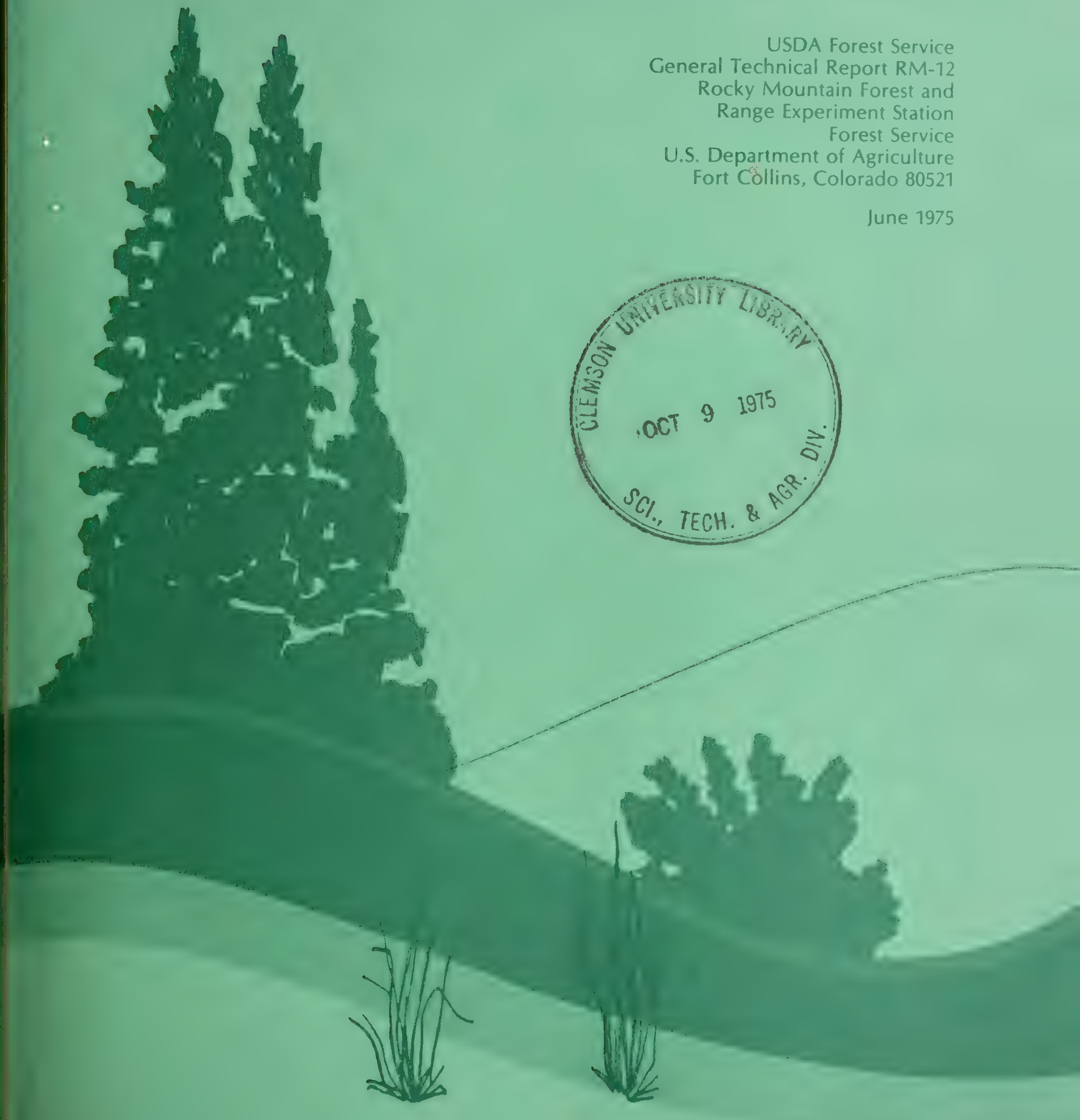

Abstract

Wirsing, John M., and Robert R. Alexander.
1975. Forest Habitat types on the Medicine Bow National Forest, southeastern Wyoming: Preliminary report. USDA For. Serv. Gen. Tech. Rep. RM-12, 11 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521

A vegetation classification based on concepts and methods developed by Daubenmire was used to identify five habitat types and their related phases on the Medicine Bow National Forest: *Abies lasiocarpa/Vaccinium scoparium,* including the *Pinus contorta/Vaccinium scoparium* community; *Abies lasiocarpa/Carex geyeri,* including the *Pinus contorta/Carex geyeri* community; *Populus tremuloides/Carex geyeri; Pinus ponderosa/Carex geyeri;* and *Pinus flexilis/Carex geyeri.* A key to identify the habitat types and management implications associated with them are provided.

Keywords: Vegetation classification, *Abies lasiocarpa, Picea engelmannii, Pinus contorta, Pinus ponderosa, Pinus flexilis, Populus tremuloides.*

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General Technical Report RM-12

June 1975

Forest Habitat Types on the Medicine Bow National Forest, Southeastern Wyoming: Preliminary Report

John M. Wirsing, Graduate Student
Washington State University
and
Robert R. Alexander, Principal Silviculturist
Rocky Mountain Forest and Range Experiment Station[1]

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Forest Habitat Types on the Medicine Bow National Forest, Southeastern Wyoming: Preliminary Report

John M. Wirsing and Robert R. Alexander

The forest vegetation of the central Rocky Mountains is a diverse mixture of communities, each of which reproduces, grows, and reacts differently in response to ecological and biological conditions. Until recently, however, little effort has been made to classify these forests into units of similar vegetation or like biological potential. In 1970, a cooperative study was started between Washington State University and the Rocky Mountain Forest and Range Experiment Station to (1) classify forest vegetation on the Medicine Bow National Forest in Wyoming into habitat types, and (2) develop a key that would be helpful in identifying these types. The classification, completed in 1972 (Wirsing 1973), was based on concepts and methods developed by Daubenmire (1952) and extended and modified by Daubenmire and Daubenmire (1968), Reed (1969), Pfister (1972), and Pfister and others (1972, 1973a, 1973b).

STUDY AREA

DESCRIPTION

The Medicine Bow National Forest is located within the mountainous areas of Carbon, Converse, and Albany counties in southeastern Wyoming. This Forest, totaling more than 1.4 million acres, is composed of four administrative units separated by extensive basins and low, broad valleys (fig. 1). Table 1 shows the size, elevation, and principal vegetation of each unit.

The **Snowy Range unit,** located within the Medicine Bow Mountain Range about 30 to 35 miles west of Laramie, extends approximately 35 miles north of the Colorado-Wyoming border. Extensive Precambrian gneiss and igneous rock, underlies most of the unit (Thornbury 1965). It is bordered on the east by the Laramie Basin, which contains sedimentary rocks ranging in age from Paleozoic to Recent, and on the west by the North Platte Valley, which contains principally sedimentary rocks of Tertiary Age. Glacial drift of Pleistocene time is abundant in the northern portion of the Snowy Range, where it originated from an ice cap near Medicine Bow Peak (Houston 1968). As a result, numerous streams and lakes are found in this area. In the southern portion, very little glacial action took place.

Across the North Platte Valley to the west lies the **Sierra Madre unit,** which extends for 40 miles along the Colorado-Wyoming border and 20 miles north of the State line. Rolling hills and less precipitous mountains than those found in the Snowy Range characterize this area. It is bordered on the north and east by bedrock of Tertiary sedimentary origin, while the west and southwest are rimmed by Tertiary igneous rock of volcanic origin. Precambrian bedrock also underlies most of this region (Thornbury 1965).

The **Pole Mountain unit,** an important recreation area, is located in the Laramie Mountain Range. It consists mainly of rolling hills with a few rugged mountainous areas. The Sherman Mountains, located in the southwest portion of the unit, are considered to be erosional remnants (Monadnocles) rising above the general level of the surface of the Laramie River. The underlying bedrock is Precambrian granite. The southern area of the unit is covered with peculiar rock formations caused by planes of weakness in the granite, dividing it into blocks, and capped with balanced rocks. In contrast, sedimentary bedrock of Paleozoic origin underlies the northwest section of the unit. High plains border this part of the National Forest on the east and west, with rolling hills to the north and south.

Located in the northernmost extension of the Laramie Mountains about 100 miles north of Laramie, the **Laramie Peaks unit** is bordered on the north and east by high plains and on the west by the Shirley Basin. To the south, it gradually extends into

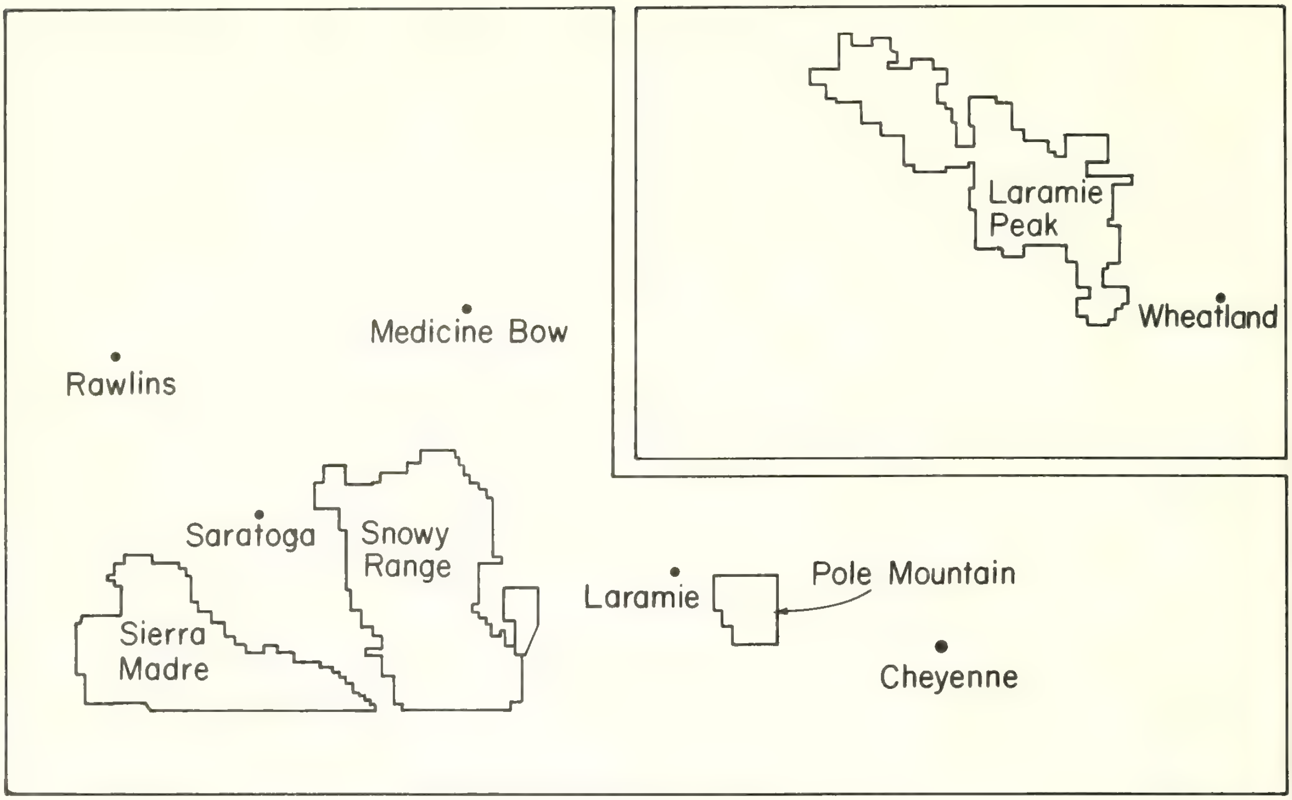

Figure 1.—Study areas on the four administrative units of the Medicine Bow National Forest, Wyoming.

Table 1.—Size, elevational range, and principal forest vegetation in the four administrative units, Medicine Bow National Forest, Wyoming

Unit	Area	Elevation	Principal forest vegetation
	Acres	*Feet*	
Snowy Range	600,000	8,000 to 12,013 (2,438 m) (3,662 m)	*Abies lasiocarpa, Picea engelmannii, Pinus contorta.*
Sierra Madre	330,000	6,500 to 11,044 (1,981 m) (3,354 m)	*Abies lasiocarpa, Picea engelmannii, Pinus contorta, Populus tremuloides.*
Pole Mountain	56,000	8,200 to 9,053 (2,499 m) (2,759 m)	*Pinus ponderosa, Pinus flexilis.*
Laramie Peaks	[1] 440,000	6,300 to 10,272 (1,920 m) (3,131 m)	*Pinus ponderosa.*

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[1] *177,000 acres are National Forest land.*

the Pole Mountain unit. The topography can be characterized as very rugged, with most of the region containing bedrock of Precambrian origin (Thornbury 1965). This unit is an important water, grazing, and recreation area for surrounding ranches and communities.

While the number of species of arboreal trees is limited on the Medicine Bow National Forest, the understory has a large variety of shrubs, graminoids, and forbs (Wirsing 1973).

CLIMATE

The precipitation pattern on the Medicine Bow National Forest is closely tied to elevation. Mean annual precipitation varies from about 15 inches (38.10 cm) at 6,000 ft (1,829 m) elevation to 25 inches (63.50 cm) or more at 10,000 ft (3,049 m) elevation. At lower elevations, about three-fourths of the precipitation falls mostly as rain during the period April through September, while at elevations above 8,000 ft (2,438 m), about two-thirds of the annual precipitation falls as snow during the period October through May.

Mean annual temperature in the *Pinus ponderosa* forest zone is about 45°F (7.2°C), with a maximum range of -40°F (-40°C) to 110°F (43.3°C). In the *Picea engelmannii-Abies lasiocarpa* forest zone, mean annual temperature is less than 35°F (1.7°C), and frost can occur any month of the year. Temperature varies from -50°F (-45.6°C) to about 90°F (32.2°C).

METHODS

FIELD SAMPLING

Preliminary work in the Medicine Bow National Forest was begun in the summer of 1970. A total of 221 reconnaissance plots were located to sample the various tree species present over a wide geographic area. For each plot, such environmental factors as location, elevation, direction and percent slope, as well as a representative list of the trees, shrubs, forbs, grasses, and sedges present in each, were recorded. All stands were selected on the basis of similarity of vegetation, relief, soil conditions, and age since the last burn. Ecotones and areas influenced by grazing were avoided.

During the summers of 1971 and 1972, fieldwork was conducted on 120 locations selected for intensive sampling. These stands were chosen from the reconnaissance plots as representative of the forest communities characterized by the following tree species: *Picea engelmannii, Abies lasiocarpa, Pinus flexilis, Pinus ponderosa, Pinus contorta,* and *Populus tremuloides.*

In each stand, plots 15 by 25 m were located where environment, overstory, and understory were similar. Each plot was selected to represent either a climatic or topographic climax or seral successional stage. Each 375 m^2 plot was then subdivided into three 5 by 25 m macroplots. Next, 20- by 50-cm microplots were located along the sides of the central macroplot at 1-m intervals to obtain 50 ground canopy coverage measurements.

All trees within each 375 m^2 plot above 1 dm in diameter, measured at breast height, were recorded in eight diameter classes; tree seedlings less than 1 dm were recorded in three additional classes. In the microplots, canopy coverage was recorded independently for each species of shrubs, graminoid, and forb as one of six coverage classes (0-5, 5-25, 25-50, 50-75, 75-95, and 95-100 percent). In addition, a second list included other species present within the 375 m^2 plot. A third list consisted of additional species outside the 375 m^2 plot.

The serotinous cone habit of *Pinus contorta* in the Rocky Mountains is an important factor in regeneration success (Lotan 1967, 1968). To determine whether a plot contained serotinous or nonserotinous cones, crowns of 10 trees within the 375 m^2 area were observed with field glasses. The type of cone behavior observed over 90 percent of the tree was then indicated on the data sheet.

ANALYSIS OF DATA

For each microplot examined, the midpoints of the coverage classes were used to calculate average percent coverage for each shrub, graminoid, and forb present. Species coverages and selected stand characteristics were then transferred to an association table. Stands were arranged and rearranged to group stands with similar floristic composition. The first major separation was based on the tree species composition and climax tree species. Habitat type separation was based on major shrubs, graminoids, and forbs. Finally, distinctive minor floristic differences were used to differentiate phases. (For further details on the method of analysis see Daubenmire 1952 and Daubenmire and Daubenmire 1968.)

TAXONOMIC CONSIDERATIONS

A majority of the forbs and shrubs were identified in the field. The forbs and graminoids that could not be positively identified as to species were sent to the U.S. Forest Service Herbarium, Fort Collins, Colorado, for verification. Nomenclature for the plant species collected is that of Weber (1967).

RESULTS

The following five habitat types and related phases were recognized:

1. *Abies lasiocarpa/Vaccinium scoparium* habitat type, which includes the *Pinus contorta/Vaccinium scoparium* community.
    a. *Sibbaldia-Bistorta* phase
2. *Abies lasiocarpa/Carex geyeri* habitat type, which includes the *Pinus contorta/Carex geyeri* community.

3. *Populus tremuloides/Carex geyeri* habitat type.

4. *Pinus ponderosa/Carex geyeri* habitat type.
    a. *Lupinus argenteus* phase
    b. *Sedum lanceolatum* phase

5. *Pinus flexilus/Hesperochloa kingii* habitat type.
    a. *Pulsatilla ludoviciana* phase
    b. *Koeleria cristata* phase

HABITAT TYPE:
ABIES LASIOCARPA/VACCINIUM SCOPARIUM

Description

The *Abies lasiocarpa/Vaccinium scoparium* habitat type, represented by 57 plots at elevations ranging from 7,710 ft (2,350 m) to 10,600 ft (3,321 m), was the most widespread habitat type found (fig. 2). It is recognized not only by the almost constant presence and reproductive success of *Abies lasiocarpa,* but also by the abundance and understory dominance of the low shrub *Vaccinium scoparium. Picea engelmannii* is frequently or occasionally present as a coclimax species, with reproduction generally from fair to poor. This habitat type is bordered at its upper limits by timberline and at its lower limits by the *Populus tremuloides/Carex geyeri* habitat type.

In the 34 stands above 8,580 ft (2,615 m), composition of the overstory is most often *Abies* and *Picea,* but occasionally stands may be dominated by either species. The only major seral species generally

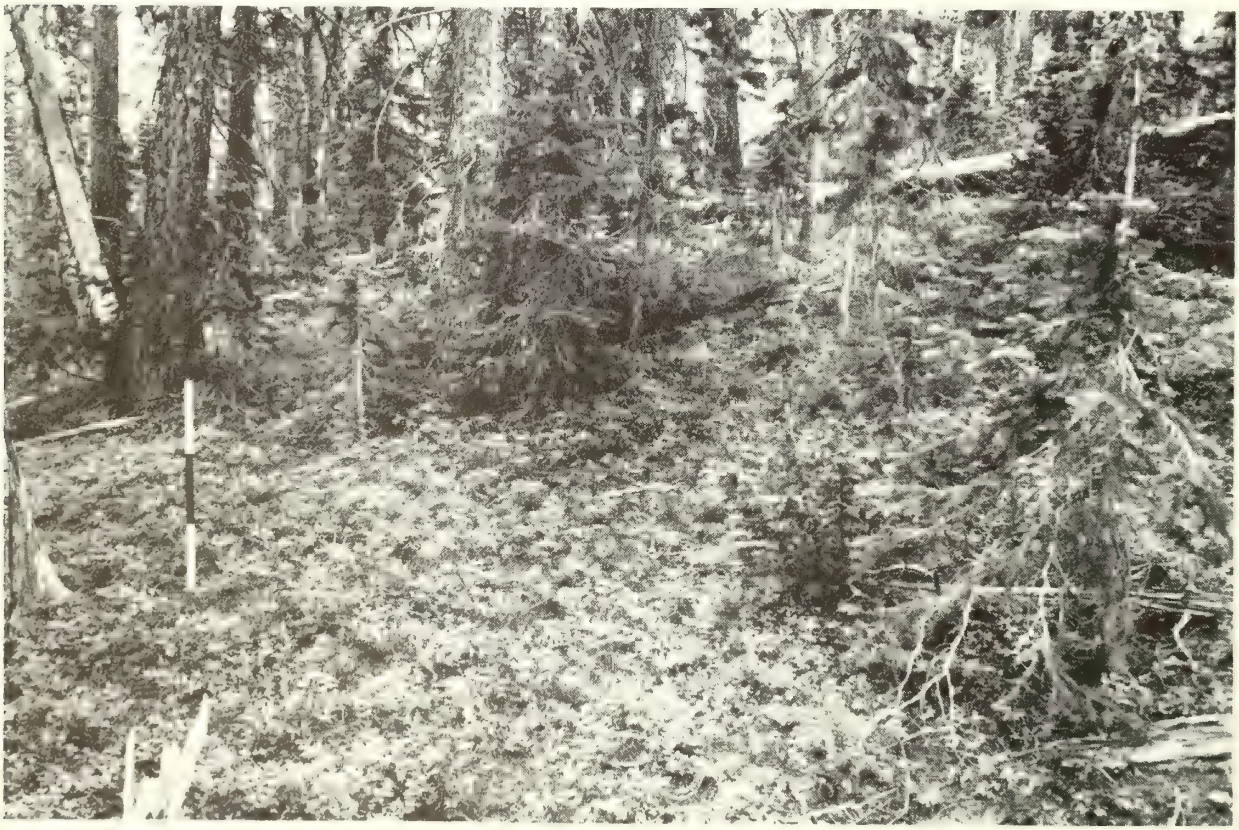

Figure 2.—*Abies lasiocarpa/Vaccinium scoparium* habitat type.

present in these old stands is *Pinus contorta.* These trees are usually large in diameter and have low reproductive success. *Pinus contorta* may occur mixed with the climax species in the overstory, or stands may be *Pinus contorta* with advanced *Abies lasiocarpa* reproduction. These latter stands are similar to the widespread seral *Pinus contorta/Vaccinium scoparium* community found at lower elevations and on south and west slopes as high as 8,800 ft (2,927 m) except that they do not cover extensive areas. *Pinus flexilis* is considered only a minor seral component in these stands. A very distinctive feature of these stands is the almost complete absence of *Populus tremuloides* as a seral species.

The understory is not so simple, with species diversity ranging from a low of five species to a maximum of 50. *Vaccinium scoparium* is the dominant shrub, with occasional *Vaccinium myrtillus, Rosa woodsii, Vaccinium caespitosum, Pyrola secunda,* and *Juniperus communis. Carex rossii, Trisetum spicatum,* and *Poa reflexa* are the most abundant graminoids, but *Carex geyeri* and *Poa nervosa* tend to be dominant wherever they occur. Understory forbs present most frequently in this habitat type are *Arnica cordifolia, Epilobium angustifolium, Erigeron peregrinus, Erythronium grandiflorum, Hieracium gracile, Thlaspi alpestre, Pedicularis racemosa,* and *Pedicularis bracteosa.*

Although stands in this habitat type appear only sporadically in the Laramie Peaks and Pole Mountain units, dense stands covering a wide area are found both in the Sierra Madre and Snowy Range units. Apparently this association thrives best in the colder, higher, and more humid climates on deep, well-drained loam soils on glacial outwash and alluvial plains. Parent material underlying this association, in both the Snowy Range and Sierra Madre units, consists of sandstone, shale, siltstone, interbedded conglomerate, glacial outwash, loess, mafic igneous rock, gneiss, and quartzite.

Fire is believed to be the major disturbance, as evidence of fire was recorded in a majority of the stands studied. Insect infestation is considered slight, since only two stands were affected. Snowmold damage is also minor, occurring only in subalpine stands over 10,000 ft (3,408 m). Broomrust often appears on *Abies lasiocarpa* in this habitat type. More of those stands infected by this disease are in the subalpine region east of the Continental Divide.

Pinus contorta/Vaccinium scoparium Community

The remaining stands sampled in this habitat type belong to the seral *Pinus contorta/Vaccinium scoparium* community. This community of fire origin is widespread on the Medicine Bow National Forest at elevations ranging from 7,710 ft (2,350 m) to 9,800 ft (2,987 m). It is recognized by the dense overstory of mature or immature *Pinus contorta* and a successfully reproducing seedling understory of *Abies lasiocarpa. Pinus contorta* probably reproduces poorly because a closed canopy cover results in light, temperature, and moisture conditions inadequate for the survival of seedlings. Other minor components or accidental species in the overstory of this association may be *Populus tremuloides, Pinus flexilis, Pinus ponderosa,* and *Pseudotsuga menziesii,* depending upon the seed source available.

The understory of these stands is quite similar and almost as varied as the vegetation found in stands dominated by *Abies-Picea,* with species diversity ranging from a low of six species to a high of 34. *Vaccinium scoparium* is the dominant shrub, but coverage values are frequently lower than in stands dominated by *Abies-Picea. Vaccinium myrtillus, Juniperus communis, Berberis repens, Pyrola secunda, Rosa woodsii,* and *Sheperdia canadensis* are the other most abundant shrub components. Of the many graminoids present within the community, *Carex rossii, Poa nervosa,* and *Trisetum spicatum* show the highest constancy. *Carex geyeri* is present in many of the plots examined whether these are dominated by *Vaccinium scoparium* or not, although the coverage value increases significantly as *Vaccinium scoparium* coverage decreases.

The most extensive mature stands of *Pinus contorta* are present in the Snowy Range and Sierra Madre units; fewer and more immature stands are located in the Pole Mountain and Laramie Peaks units. The association occurs over a wide range of soils, but seems to thrive best on moderately acid sands or gravelly loams.

Data collected on the fruiting habit of *Pinus contorta* indicate that nonserotiny is more prevalent in plots above 9,100 ft (2,774 m) elevation, while serotiny occurs with more frequency at lower elevations. These findings are in agreement with the results obtained by Lotan (1963).

Arceuthobium americanum often reduces growth in mature stands of *Pinus contorta* and kills new reproduction. It was observed on only seven of the study plots, however.

Sibbaldia-Bistorta Phase

This weakly defined phase, found at elevations above 8,580 ft (2,615 m), is distinguished only by the presence of *Bistorta bistortoides, Sibbaldia procumbens, Draba crassifolia, Potentilla diversifolia, Ranunculus eschscholtzii,* and *Senecio dimorphophyllus.*

Management Implications

Understory vegetation changes slowly after major disturbance. Competition between tree seedlings and understory vegetation is not severe. In stands dominated by *Abies* and *Picea* there is frequently a manageable stand of advanced reproduction. Timber productivity is average. Clearcutting in small patches (5 acres or less) or narrow (400-ft wide) strips, and shelterwood and group selection cutting may be used on north and east slopes where natural reproduction is desired. Shelterwood and group selection cutting should be used on south and west slopes unless artificial regeneration is planned. Seedbed preparation will be needed where the L, F, or H layers exceed 2 inches in depth. In stands dominated by *Pinus contorta,* timber productivity is average to above average. Small patch or strip clearcuts should be used where pine reproduction is desired in stands with *Abies* and *Picea* advanced reproduction or in pure *Pinus contorta* stands where the cone habitat is nonserotinous. Shelterwood cutting is an additional alternative, but it may be difficult to regenerate *Pinus contorta* unless stands are pure *Pinus contorta.* In stands dominated by *Pinus contorta* where pine reproduction is desired, larger clearcut openings (up to 40 acres) may be used if the cone habitat is serotinous. Large clearcut openings in nonserotinous stands will require artificial regeneration. This habitat type is big-game summer range and occupies elevations where snowfall is heavy. Small patch or strip clearcuts result in greater production of forage for big-game and larger increases in water available for streamflow than either shelterwood or group selection cutting.

HABITAT TYPE:
ABIES LASIOCARPA/CAREX GEYERI

Description

The *Abies lasiocarpa/Carex geyeri* habitat type is prevalent throughout the Medicine Bow National Forest. The overstory is composed of the same tree species as found in the *Abies/Vaccinium scoparium* habitat type. Understory components are also similar to the *Abies/Vaccinium scoparium* habitat type, with the exception that *Carex geyeri* is dominant over *Vaccinium scoparium* if the *Vaccinium* is represented at all.

This habitat type is represented by five plots dominated by an *Abies-Picea* overstory and by 10 plots in a seral *Pinus contorta/Carex geyeri* community (fig. 3). This habitat type is usually found at lower elevations (mean elevation of 8,730 ± 59 ft).

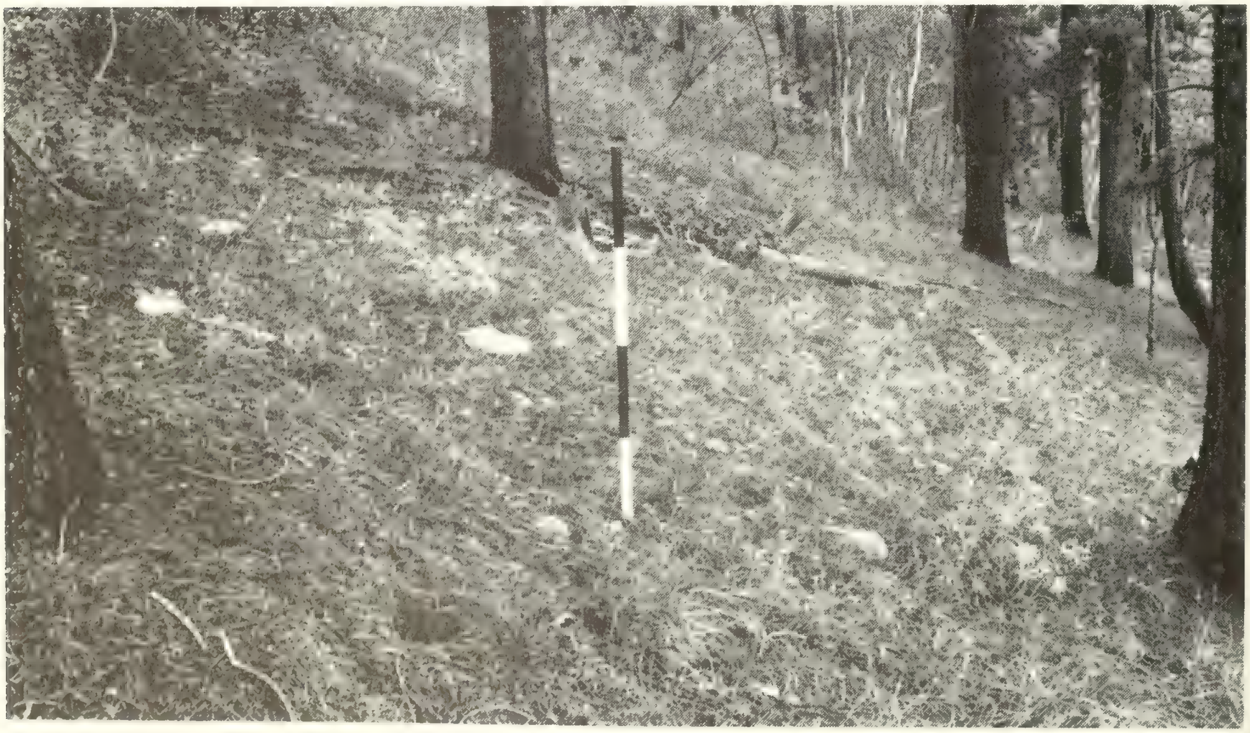

Figure 3.—*Pinus contorta/Carex geyeri* community (*Abies lasiocarpa/Carex geyeri* habitat type).

Management Implications

Understory vegetation in this habitat type recovers slowly from major disturbance. Reproduction in this drier habitat type is likely to be more difficult to obtain, and competition between tree seedlings and understory vegetation more severe than in the higher *Abies/Vaccinium* habitat type. In stands dominated by either *Abies-Picea* or *Pinus contorta,* timber productivity is average to below average. Cutting methods applicable are similar to those suggested for the *Abies/Vaccinium* habitat type. This habitat type provides forage for domestic livestock and big-game. Heavy grazing may reduce the *Carex* cover and expose soils difficult to revegetate.

HABITAT TYPE:
POPULUS TREMULOIDES/CAREX GEYERI

Description

The *Populus tremuloides/Carex geyeri* habitat type was observed in all four units of the Medicine Bow National Forest (fig. 4.). Usually, it appears in small clonal patches scattered over the landscape at the lower fringes of the coniferous forest. On the western slope of the Sierra Madre unit, however, stands appear extensively on cooler and more moist sites where porous humic soils are found. A total of 19 plots, ranging in elevation from 7,750 ft (2,362 m) to 9,025 ft (2,751 m) and representing a wide variety of topographic aspects and degrees of slope, were examined. Bordering and frequently represented in this association as minor accidentals with low reproductive success are such tree species as *Picea engelmannii, Pinus contorta, Pinus flexilis,* and *Pinus ponderosa.* The majority of these stands are located west of the Continental Divide.

This association is quite distinctive from all other *Populus tremuloides* habitat types identified to date in the Rocky Mountains. It has *Carex geyeri* regularly present and important in the understory. It lacks *Symphoricarpos oreophilus,* which was so distinctive in the *Populus tremuloides* habitat types found in the Wind River Mountains in western Wyoming (Reed 1969). The understory is generally quite lush, with a shrub layer composed of *Juniperus communis, Rosa woodsii, Amelanchier alnifolia,* and *Berberis repens.* Other graminoids and forbs of high

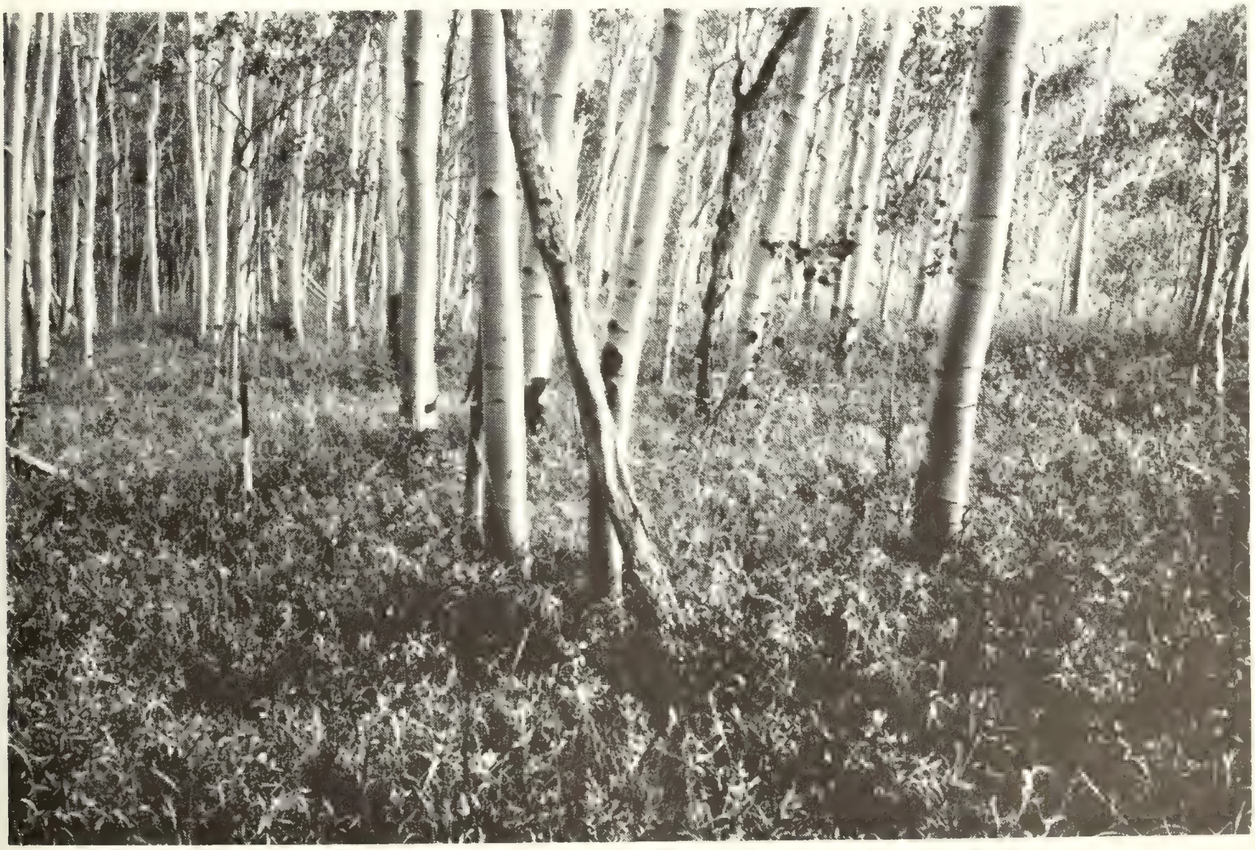

Figure 4.—*Populus tremuloides/Carex geyeri* habitat type.

constancy found in the understory are *Elymus glaucus, Achillea lanulosa, Arnica cordifolia, Galium boreale,* and *Osmorhiza depauperta.*

Carex geyeri has a high constancy value (89 percent) but a low average canopy coverage (25 percent). *Arnica cordifolia* is widely distributed, with a high constancy value and a low canopy coverage value, but much lower than that attained by *Carex geyeri.* In addition, species diversity of the understory vegetation covers a wide range from a low of 20 to a high of 47 species.

Although only seven out of the 19 plots examined had any visible evidence of fire, the role of fire in the maintenance of this habitat type is not fully understood. Most of the study plots appeared to have been grazed, but reproduction was prolific in the majority of plots examined. Parent material of this habitat type, in both the Snowy Range and Sierra Madre units, consists of sedimentary rock, glacial outwash, loess, shale, gneiss, mafic igneous rock, terrace deposits of alluvium, and limestone.

Management Implications

Relatively little information is available on the management of this habitat type. Timber productivity is average to above average. *Populus tremuloides* can be maintained by clearcutting in small patches or strips. This habitat type is grazed by big-game and livestock. Heavy grazing may reduce *Carex* cover and expose soils that are difficult to revegetate. This habitat type is also valuable for the fall color it provides.

HABITAT TYPE:
PINUS PONDEROSA/CAREX GEYERI

Description

This climax association is characterized by a lush understory beneath a pure or almost pure cover of *Pinus ponderosa.* Shrubs frequently present in the undergrowth are *Arctostaphylos uva-ursi, Juniperus communis, Berberis repens,* and *Sedum lanceolatum.* The graminoids are well represented by *Carex geyeri* and *Hesperochloa kingii.* The most frequently encountered forbs are *Arnica cordifolia, Campanula rotundifolia, Cirsium canescens, Crepis acuminata,* and *Potentilla fissa.* Species diversity within the understory covers a wide range, from a low of 19 species to a very high total of 52.

Extensive stands of *Pinus ponderosa* are restricted to the Laramie Peaks unit, while only a few dwindling relics remain in the Snowy Range unit. A few immature stands are also found within the Pole Mountain unit, but no *Pinus ponderosa* was observed in the Sierra Madre unit. This association occurs on well-drained, deep, sandy, graveled, or clay-loam soils. Thirteen plots, ranging in elevation from 6,150 ft (1,875 m) to 8,480 ft (2,585 m), and on varying topographic aspects, were studied. Such tree species as *Pinus contorta, Pinus flexilis,* and *Populus tremuloides* are occasionally represented, but are minor accidentals. The majority of the stands are located east of the Continental Divide.

The *Pinus ponderosa/Carex geyeri* habitat type occurs under a variety of soil and climatic conditions, but it is confined to areas of relatively low rainfall. Reproduction, which was low in most of the plots, seemed to follow an episodic cycle. This cycle may be caused by vagaries in weather that influence seed set and seedling mortality, or by the influence of fire which destroys seedlings in certain years. With the decrease in the occurrence of fire due to the present fire prevention policy, both the forbs and graminoids found in these plots may provide competition that is too formidable for the seedlings to survive. Evidence of fire was found in seven of the 13 plots studied. Damage from dwarf mistletoe was not observed in any of the areas, and only one stand had an insect infestation.

Lupinus argenteus Phase

The most critical indicator plant of this phase is *Lupinus argenteus.* Other significant species characteristic of the seven plots of this unit are *Berberis repens, Cirsium canescens,* and *Apocynum androsaemifolium. Arctostaphylos uva-ursi* is the least critical indicator, since its appearance and abundance over the landscape is erratic. This phase can be recognized in the Laramie Peaks unit as well as in the relic stands present within the Snowy Range unit.

Sedum lanceolatum Phase

Sedum lanceolatum is the major indicator plant in the six plots representing this phase. It is further identified by the complete absence of *Lupinus argenteus, Berberis repens,* and *Cirsium canescens.* It can be observed not only in the Laramie Peaks unit, but to a limited extent in the Pole Mountain and Snowy Range units.

Management Implications

This habitat type is valuable for forage production and recreational use; timber productivity is low. Heavy grazing by either big-game animals or domestic livestock may be destructive to the *Carex* cover. On areas harvested for timber, shelterwood, group selection, and individual-tree selection cutting may be used. Stand density should be kept low to minimize damage from mountain pine beetle. Reproduction is likely to be difficult to obtain in years of low rainfall. Seedbed preparation will be needed to reduce competition, but care must be taken not to destroy the *Carex* cover.

HABITAT TYPE: *PINUS FLEXILIS/HESPEROCHLOA KINGII*

Description

The *Pinus flexilis/Hesperochloa kingii* habitat type is distinguished from all other habitat types by the consistent presence of *Hesperochloa kingii* in the understory of *Pinus flexilis* stands. *Pinus contorta, Abies lasiocarpa,* and *Populus tremuloides* occur as minor accidentals.

The understory vegetation of this habitat type is usually sparse and low. *Artemisia tridentata, Juniperus communis,* and *Ribes cereum* are the most frequent shrubs, but their coverage value is quite low. The most consistent grasses are *Hesperochloa kingii, Agropyron spicatum, Koeleria cristata,* and *Poa cusickii,* while the forbs are usually *Antennaria rosea, Arenaria congesta, Erigeron flagellaris, Sedum lanceolatum,* and *Potentilla fissa.* Species diversity varies considerably from stand to stand, with a recorded low of 25 species to a high of 42.

Open stands of the *Pinus flexilis/Hesperochloa kingii* habitat type are found in all four units of the Medicine Bow National Forest, but the most extensive stands are located in the Pole Mountain unit. It is a topographic climax within the *Pica engelmannii-Abies lasiocarpa* zone, and is representative of dry, stony soils of ridgetops, especially with southwesterly windswept exposures. Ten plots, ranging in elevation from 8,425 ft (2,568 m) to 9,790 ft (2,984 m) were observed. These small, widely distributed stands are usually bordered by *Pinus contorta* and *Abies lasiocarpa.* All permanent plots were located east of the Continental Divide.

Due to the harshness of the microclimatic conditions of this habitat, reproduction is sporadic and slow. Most of the seed production may be destroyed by small animals. The seeds not consumed usually germinate in clusters of four to seven, but only one, or possibly two, may survive to maturity. Fire, also a threat to reproductive success in this habitat type, occurred in five of the stands examined. *Arceuthobium* sp., in advanced stages, was observed in only one plot in the Pole Mountain unit. Isolated stands of *Pinus flexilis* known to exist in the southwestern portion of the Laramie Peaks unit, were not studied.

Pulsatilla ludoviciana Phase

The stands that represent this phase are found mainly in the Sierra Madre and Snowy Range units and, to a limited extent, in the Pole Mountain unit. It is distinguished by the presence of the forbs *Pulsatilla ludoviciana* and *Phlox multiflora,* and by the frequent absence of grasses such as *Koeleria cristata* and *Poa cusickii.*

Koeleria cristata Phase

Indicators of this phase can be recognized frequently in the Pole Mountain and Sierra Madre units and occasionally in the Snowy Range unit. It is distinguished by the constant presence of *Koeleria cristata,* and the usual presence of *Poa cusickii* and the absence of *Pulsatilla ludoviciana* and *Phlox multiflora.*

Management Implications

This dry habitat type is of little interest or value for timber production. Its primary use is for forage by big-game and livestock.

OTHER VEGETATION COMMUNITIES

Several other minor plant communities present in the Medicine Bow National Forest were not included in this study. These minor components within a complex forest mosaic represent topographic, edaphic, or other special environmental conditions not characteristic in the major habitat types and phases. The following are additional plant communities observed during this study.

Juniperus scopulorum Community

Small patches of this hardy shrub are found in the southern portion of the Laramie Peaks unit. Also, the species was observed as a minor accidental in the *Pinus ponderosa/Carex geyeri* habitat type.

Pseudotsuga menziesii Community

Pseudotsuga menziesii is poorly represented in the forested areas studied. No communities dominated by this tree were observed in either the Laramie Peaks or Sierra Madre units. However, it does appear at low elevations on the western margins of the Snowy Range unit, (Hana 1934) and on shaded slopes on the north side of Telephone Canyon between Laramie and Cheyenne. At the latter location, it was heavily logged in the past, probably during the construction of the Union Pacific Railroad. It is quite possible that these trees are remnants from previous extensive forests of this species. The vegetation classification map of the Medicine Bow National Forest (Douglas 1913) shows *Pseudotsuga* stands on the west side of the Snowy Range unit.

Quercus gambellii Community

Quercus gambellii, a small deciduous tree or shrub, is abundant in the dry foothills and canyon walls on the southwestern edge of the Sierra Madre unit. Generally, it is confined to the lower fringes of the Montane Zone below the *Abies-Picea* and *Pinus contorta* communities. This xerophytic community was not observed in any other area of the Medicine Bow National Forest.

Alnus tenuifolia Community

This shrub community was observed along the roadside and streambanks on the western slope of the Sierra Madre unit. Usually it is confined to pond borders and sites along mountain streams, but it may form more extensive stands in other areas. This species is associated with the distribution of the *Abies lasiocarpa/Vaccinium scoparium* habitat types.

KEY TO FOREST HABITAT TYPES

The following key to the major forest associations of southeastern Wyoming has been prepared to identify habitat types and phases present in relatively undisturbed stands.

1. *Pinus ponderosa* present and reproducing; other conifers absent .... *PINUS PONDEROSA/ CAREX GEYERI* HABITAT TYPE (2)

  2. *Lupinus argenteus, Berberis repens, Cirsium canescens, Apocynum androsaemifolium* usually present .... *LUPINUS ARGENTEUS* PHASE

  2. *Lupinus argenteus, Berberis repens, Cirsium canescens, Apocynum androsaemifolium* usually absent; *Sedum lanceolatum* usually present .... *SEDUM LANCEOLATUM* PHASE

1. *Pinus ponderosa* absent, or other trees well represented .... (3)

  3. *Populus tremuloides* is the sole tree reproducing well .... *POPULUS TREMULOIDES/ CAREX GEYERI* HABITAT TYPE

  3. *Populus tremuloides* absent, or at least poorly represented .... (4)

    4. *Pinus flexilis* absent or poorly reproducing; *Abies lasiocarpa, Picea engelmannii,* or *Pinus contorta* well represented . (5)

      5. *Vaccinium scoparium* dominant in the undergrowth; *Carex geyeri* a minor species, if at all present ..... (6)

        6. *Sibbaldia procumbens, Bistorta bistortoides, Draba crassifolia, Potentilla diversifolia, Ranunculus eschscholtzii,* and *Senecio dimorphophyllus* absent .... *ABIES LASIOCARPA / VACCINIUM SCOPARIUM* HABITAT TYPE

        6. *Sibbaldia procumbens, Bistorta bistortoides, Draba crassifolia, Potentilla diversifolia, Ranunculus eschscholtzii,* and *Senecio dimorphophyllus* present singly or collectively .... *ABIES LASIOCARPA/ VACCINIUM SCOPARIUM* HABITAT TYPE, *SIBBALDIA-BISTORTA* PHASE

      5. *Carex geyeri* dominant in the undergrowth; *Vaccinium scoparium* absent ...... *ABIES LASIOCARPA/ CAREX GEYERI* HABITAT TYPE

    4. *Pinus flexilis* dominant and reproducing .... *PINUS FLEXILIS/HESPEROCHLOA KINGII* HABITAT TYPE (7)

      7. *Phlox multiflora* and/or *Pulsatilla ludoviciana* usually present .... *PULSATILLA LUDOVICIANA* PHASE

      7. *Phlox multiflora* and *Pulsatilla ludoviciana* absent; *Koeleria cristata* and/or *Poa cusickii* usually present . . . *KOELERIA CRISTATA* PHASE

The distribution and successional status of tree species in relation to habitat type are shown in figure 5.

Figure 5.—
Distribution of tree species
through the series of habitat types,
showing dynamic status:
C = major climax species
S = seral
(S) = seral in certain areas of the type
A = accidentals

Habitat Type \ Species	*Abies lasiocarpa*	*Picea engelmannii*	*Pinus ponderosa*	*Populus tremuloides*	*Pinus contorta*	*Pinus flexilis*	*Pseudotsuga menziesii*
Abies lasiocarpa/Vaccinium	C	C		(S)	S	(S)	
Abies lasiocarpa/Carex	C	C	A	(S)	S	(S)	A
Populus tremuloides/Carex	A	A	A	C	A	A	
Pinus ponderosa/Carex			C	A	A	A	
Pinus flexilis/Hesperochloa	A			A	A	C	

LITERATURE CITED

Daubenmire, R.
1952. Forest vegetation of northern Idaho and adjacent Washington and its bearing on concepts of vegetation classification. Ecol. Monogr. 22:301-330.

Daubenmire, R.
1959. A canopy-coverage method of vegetation analysis. Northwest. Sci. 33:43-64.

Daubenmire, R., and Jean B. Daubenmire.
1968. Forest vegetation of eastern Washington and northern Idaho. Wash. Agric. Exp. Stn. Tech. Bull. 60, 104 p.

Douglas, L. H.
1913. Grazing classification map of the Medicine Bow National Forest. U.S. Geol. Survey. 7 sheets, Color.

Hana, Leo A.
1934. The major plant communities of the headwater areas of the Little Laramie River, Wyoming. Univ. Wyo. Publ. Bot. 1(10):243-266.

Houston, R. E.
1968. The geological survey of Wyoming. Univ. Wyo., Mem. No. 1, 167 p. Laramie, Wyo.

Lotan, James E.
1963. Sampling serotinous cones in lodgepole pine. Mont. Acad. Sci. Proc. 23:22-24.

Lotan, James E.
1967. Cone serotiny of lodgepole pine near west Yellowstone, Montana. For. Sci. 13:55-59.

Lotan, James E.
1968. Cone serotiny of lodgepole pine near Island Park, Idaho. U.S. For. Serv. Res. Pap. INT-52, 6 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Pfister, Robert D.
1972. Vegetation and soils in the subalpine forests of Utah. Ph.D. Diss. 98 p. Wash. State Univ., Pullman, Wash.

Pfister, Robert D., Steven F. Arno, Richard C. Presby, and Bernard L. Kovalchik.
1972. Preliminary forest habitat types of western Montana. U.S. Dep. Agric., For. Serv., Intermt. For. and Range Exp. Stn. and Reg. 1, Mimeo. Rep., 78 p. Ogden, Utah.

Pfister, Robert D., Steven F. Arno, Bernard L. Kovalchik, and Richard C. Presby.
1973a. Preliminary forest habitat types of central and eastern Montana. U.S. Dep. Agric., For. Serv., Intermt. For. and Range Exp. Stn. and Reg. 1, Mimeo. Rep., 82 p. Ogden, Utah.

Pfister, Robert D., Robert Steel, Russell A. Ryker, and Joy A. Kittams.
1973b. Preliminary forest habitat types of the Boise and Payette National Forests. U.S. Dep. Agric., For. Serv., Intermt. For. and Range Exp. Stn. and Reg. 4, Mimeo. Rep., 61 p. Ogden, Utah.

Reed, Robert M.
1969. A survey of forest vegetation in the Wind River Mountains of Wyoming. Ph.D. Diss. 77 p. Wash. State Univ., Pullman, Wash. [Diss. Abstr. 30(7) 3051 B, 1970.]

Thornbury, W. D.
1965. Regional geomorphology of the western United States. 609 p. John Wiley and Sons, Inc., N.Y., N.Y.

Weber, W. A.
1967. Rocky Mountain flora. 437 p. Univ. Colo. Press, Boulder, Colo.

Wirsing, John M.
1973. Forest vegetation in southeastern Wyoming. M.S. Thesis, 170 p. Wash. State Univ., Pullman, Wash.

Wirsing, John M., and Robert R. Alexander.
1975. Forest habitat types on the Medicine Bow National Forest, southeastern Wyoming: Preliminary report. USDA For. Serv. Gen. Tech. Rep. RM-12, 11 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521

A vegetation classification based on concepts and methods developed by Daubenmire was used to identify five habitat types and their related phases on the Medicine Bow National Forest: *Abies lasiocarpa/Vaccinium scoparium*, including the *Pinus contorta/Vaccinium scoparium* community; *Abies lasiocarpa/Carex geyeri*, including the *Pinus contorta/Carex geyeri* community; *Populus tremuloides/Carex geyeri; Pinus ponderosa/Carex geyeri;* and *Pinus flexilis/Carex geyeri.* A key to identify the habitat types and management implications associated with them are provided.

Keywords: Vegetation classification, *Abies lasiocarpa, Picea engelmannii, Pinus contorta, Pinus ponderosa, Pinus flexilis, Populus tremuloides.*

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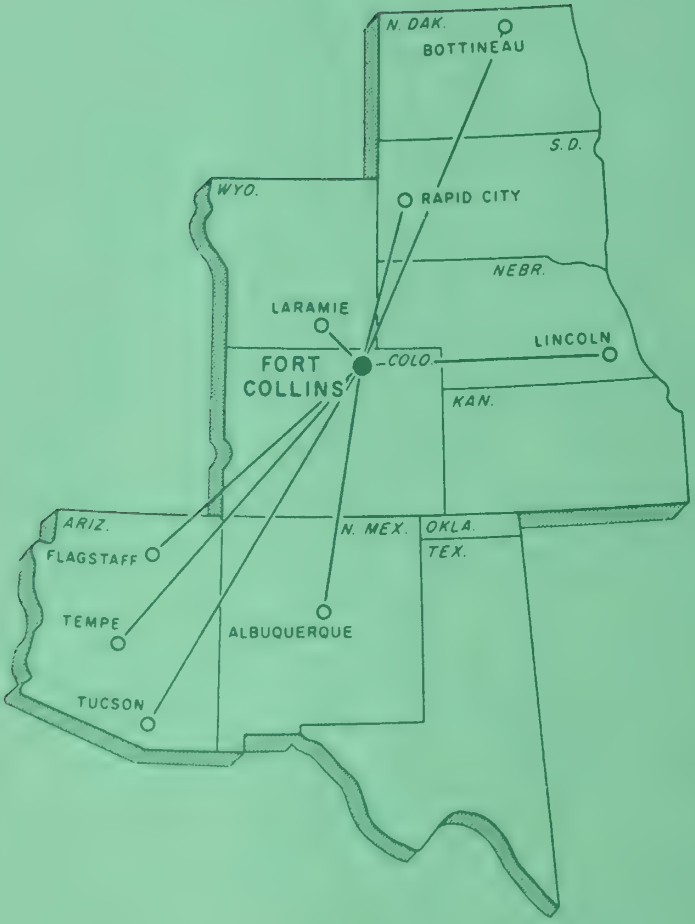
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Hydrology of Black Mesa Watersheds, Western Colorado

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Hydrology of Black Mesa Watersheds, Western Colorado

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Hydrology of Black Mesa Watersheds, Western Colorado

Runoff and sediment production are important considerations in multiple use management of mountain rangelands. The problem is to find ways to predict these factors from easily measured values.

The wasteland look of heavily grazed ranges from earlier eras focused attention on the role of plant cover. The results of numerous infiltrometer studies have been used to quantify the relation between the amount of vegetative cover and runoff and sediment. For example, Turner and Dortignac (1954) evaluated infiltrometer measurements on several mountain grassland types in western Colorado. They concluded that dense Thurber fescue sites averaging 6 percent bare soil provided maximum protection for the soil, while poor weed types with 58 percent bare soil did not furnish adequate watershed protection. Packer (1951) recommended ground-cover densities (plant basal area plus litter) of 70 percent as one watershed protection criterion for bluebunch wheatgrass and cheatgrass ranges.

Evidence from mountain range watersheds, though relatively scarce, shows soil erosion and storm runoff increase rapidly as plant cover and litter diminish. One study in Utah sets the threshold level for this increase at exposure of more than one-third of the soil surface (USDA-FS 1948). Thus ground cover—or its near complement, bare-soil intercept—has become a basic part of the watershed protection criteria evaluated by managers of mountain rangeland. For rangelands at high elevations, little attention has been paid to the role of melting snow in causing erosion, possibly because land managers were impressed by the role of intense summer storms, or because they had little occasion to visit the mountain ranges in the spring.

For 11 years, starting in 1957, precipitation, streamflow, and sediment were measured from three small watersheds on Black Mesa (fig. 1) in the mountain grasslands of western Colorado to obtain information about hydrologic processes. Ground-cover

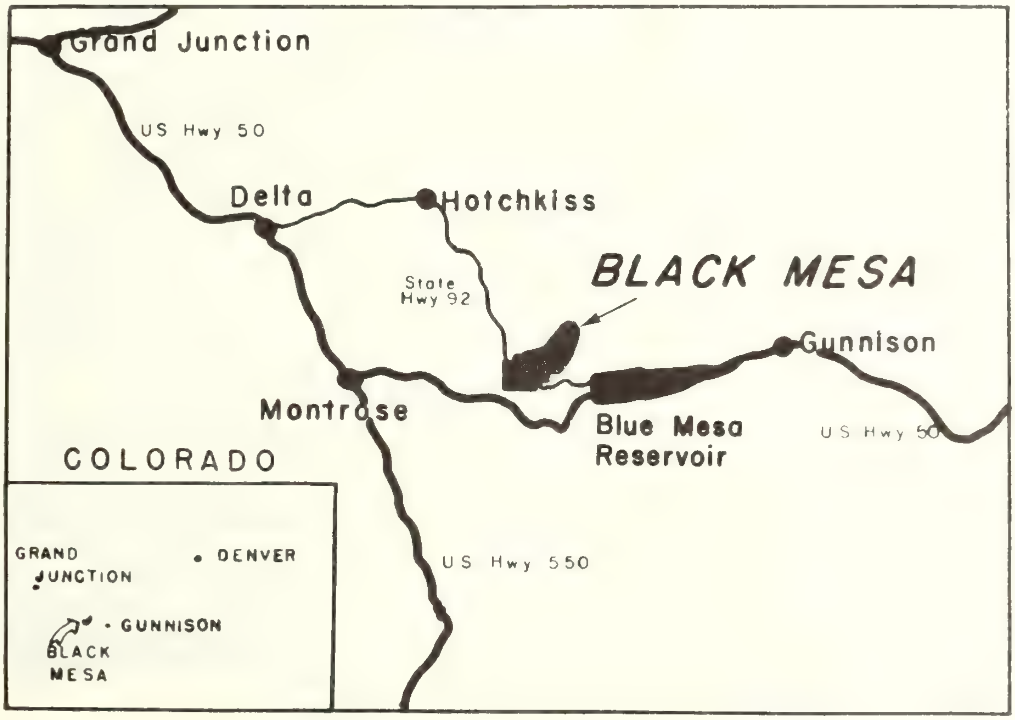

Figure 1.—Location of Black Mesa Experimental Range on the Western Slope.

transect data were also obtained. A primary purpose was to test one method of estimating plant and ground cover as it relates to runoff and sediment production.

PHYSICAL CHARACTERISTICS

Location

The three gaged watersheds that make up part of Black Mesa lie on the Gunnison National Forest, west of the town of Gunnison (latitude 38°N., longitude 107°W.). The 9,800-foot contour wanders through approximately the mid-area of each of the three watersheds. Watersheds 4 and 5 (figs. 2 and 3) drain west into Mesa Creek, and watershed 6 (fig. 4) drains south to Myers Gulch, both tributaries of the Gunnison River.

Geology, Soils, and Physiography

Paulsen (1969) describes the geology and soils as follows:

> Black Mesa is a segment of the Colorado Plateau at the western extremity of the Elk Mountains. The mesa is capped by a layer of volcanic material, principally Piedra rhyolite and Huerta andesite. The surface is dissected by streams which drop steeply from the rim to the major drainages which bound the mesa: Crystal Creek on the northwest, Curecanti Creek on the southeast, and the Gunnison River on the southwest. The loamy soils are generally fertile and productive, and range in thickness from a few inches to 3 feet or more. They grade into a tighter subsoil and unconsolidated rock. The solum may be more than 8 feet thick. Surface soils are relatively high in infiltration, water-holding capacities, and resistance to erosion.

Physiographic factors were derived from aerial photos and field survey in 1960. The watersheds differ appreciably in area, total stream length, and drainage density (table 1). Also, in 1953 a stock pond was excavated on watershed 5.

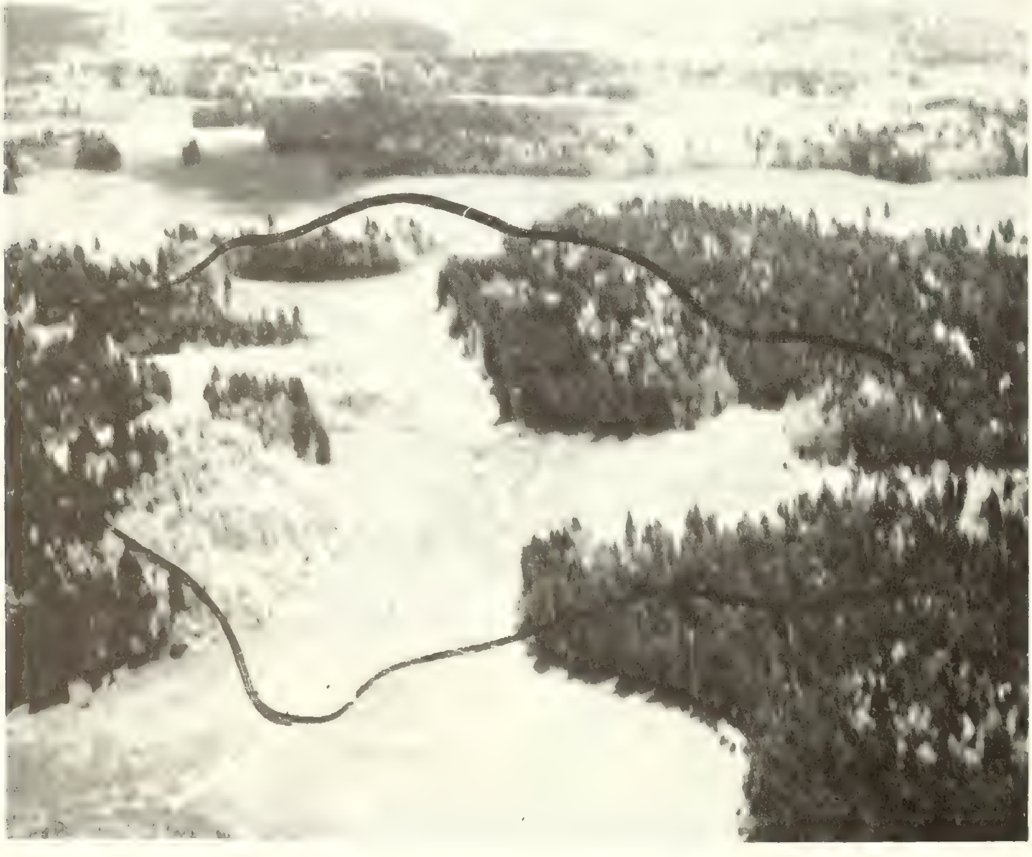

Figure 2.—Half the area of watershed 4 is in spruce-fir types.

Figure 3.—

Open herbaceous type predominates on watershed 5.

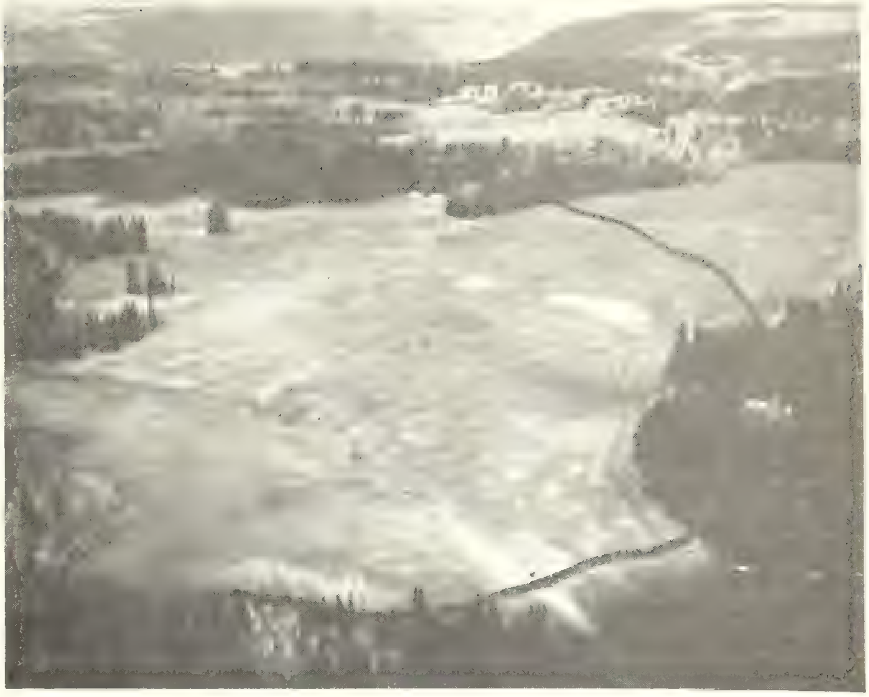

Figure 4.—

Wind-screened areas extending above the gage site on watershed 6.

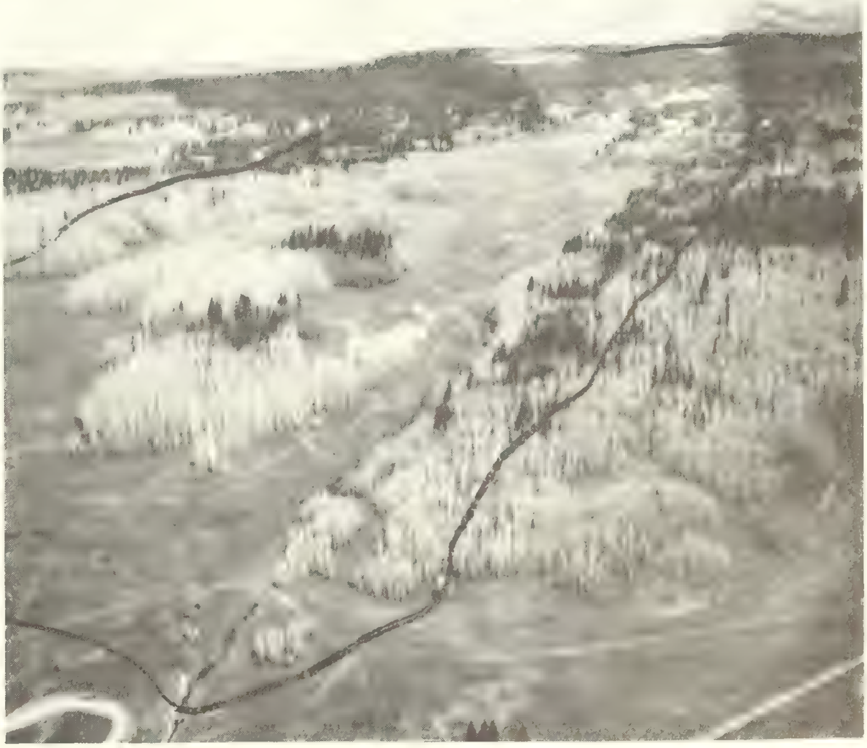

Table 1.--Physiographic data for Black Mesa experimental watersheds, Gunnison National Forest

Watershed	Area	Elevation	Total length of-- Streams	Total length of-- Roads	Drainage density
	Acres	*Feet*	- - *Miles*	- -	*Mi/mi*^{2}
4	91	9,730-9,840	1.3	0.44	9.1
5	169	9,770-9,860	1.3	.53	4.9
6	272	9,620-9,880	3.3	.83	7.8

Vegetation

The plant cover is broadly classified as aspen, spruce-fir, and herbaceous (fig. 5). The last, commonly referred to as Thurber fescue grassland, occupies 34 percent of watershed 4, 57 percent of watershed 5, and 47 percent of watershed 6 (table 2). A mixed grass-weed complex occupies the largest area within the herbaceous type. Needlegrasses (*Stipa lettermanii* Vasey and *S. columbiana* Macoun) and Idaho fescue (*Festuca idahoensis* Elmer) are frequently found components. Other sites include: areas dominated by Thurber fescue (*F. thurberi* Vasey), wet and semi-wet meadows with an abundance of grass and forb species, and hummocky areas, termed mima mounds. On some mounds Thurber fescue predominates; on others, hairy goldaster (*Chrysopsis villosa* [Pursh] Nutt. ex DC.) is the major species, or the two intermix.

Table 2.--Distribution of major vegetation types on Black Mesa experimental watersheds, Gunnison National Forest

Vegetation type	Watershed 4		Watershed 5		Watershed 6	
	Acres	*Percent*	*Acres*	*Percent*	*Acres*	*Percent*
Aspen	10	11.0	10	5.9	91	33.4
Spruce	50	54.9	16	9.5	21	7.7
Mixed	0	0	46	27.2	32	11.8
Grassland	31	34.1	97	57.4	128	47.1
Total	91	100.0	169	100.0	272	100.0

While grassland dominates the cover of watersheds 5 and 6, spruce timber occupies more than half the area of watershed 4. Aspen is the predominant timber type on watershed 6. A mixture of spruce-fir and aspen, termed mixed timber, occupies 27 percent of the area of watershed 5. A timber survey in 1959 found the average age in the aspen type to be 104 years and in the spruce to be 95 years. Basal area per acre determined from that survey averaged 224 ft^2 for aspen, 225 ft^2 for spruce, and 160 ft^2 for the mixed timber type.

HYDROLOGIC CHARACTERISTICS

Precipitation

Daily precipitation was recorded from 1920 to 1941 at the Knott Ranch, located approximately 2 miles southeast and 500 ft lower than the experimental area. Mean annual precipitation, measured by water year (October 1 through September 30), at that location was 22.5 inches. Minimum annual precipitation of 13.5 inches occurred in 1931. Maximum precipitation was 29.0 inches in 1929. From 1906 to 1920, records were kept at another location 2 miles further east of the Knott Ranch and about 1,200 ft lower. Annual precipitation averaged 21.8 inches, with maximum and minimum years showing less of a spread than the Knott Ranch record. Sixty-two percent of the annual precipitation fell between October and May.

Two Sacramento 100-inch storage gages with Alter shields were put in operation on the experimental area in the winter of 1958. These were recharged each October, and measured during the spring and at the end of the water year. For the 1958-67 period, precipitation averaged 28 inches. On the average, 71 percent is recorded between October and May. The remainder, termed growing-season precipitation, has ranged from 5 to 14 inches.

In addition to the gages, five snow courses have been run at the same locations each year since 1958. The storage gages and the snow courses (fig. 5) were located to supply precipitation data for the experimental area as a whole.

In 1957, snow courses were run to sample differences among the spruce-fir, aspen, and herbaceous types. The water equivalent on the spruce course was 64 percent, and on the aspen course 90 percent, of the mean for the herbaceous type. Watershed 4 with 55 percent of its area in the spruce type (compared to 10 and 8 percent for watersheds 5 and 6) may accumulate less snow on the average. Snow accumulation on watershed 5 is affected by wind scour in the large, open herbaceous areas. Watershed 6, with the least area in spruce and a long, narrow, protected area probably accumulates the most snow.

Two of the five snow courses encircle the storage gages. The 10-year mean difference between these two snow courses and storage gage catch is not significant at the 5 percent level. Comparable measurements show that the two methods of sampling precipitation to determine long-term means are equally precise. Encircling snow course and gage precipitation measurements are highly correlated ($r = 0.90$), but the ± 2-inch standard error of estimate seriously limits using a regression equation for

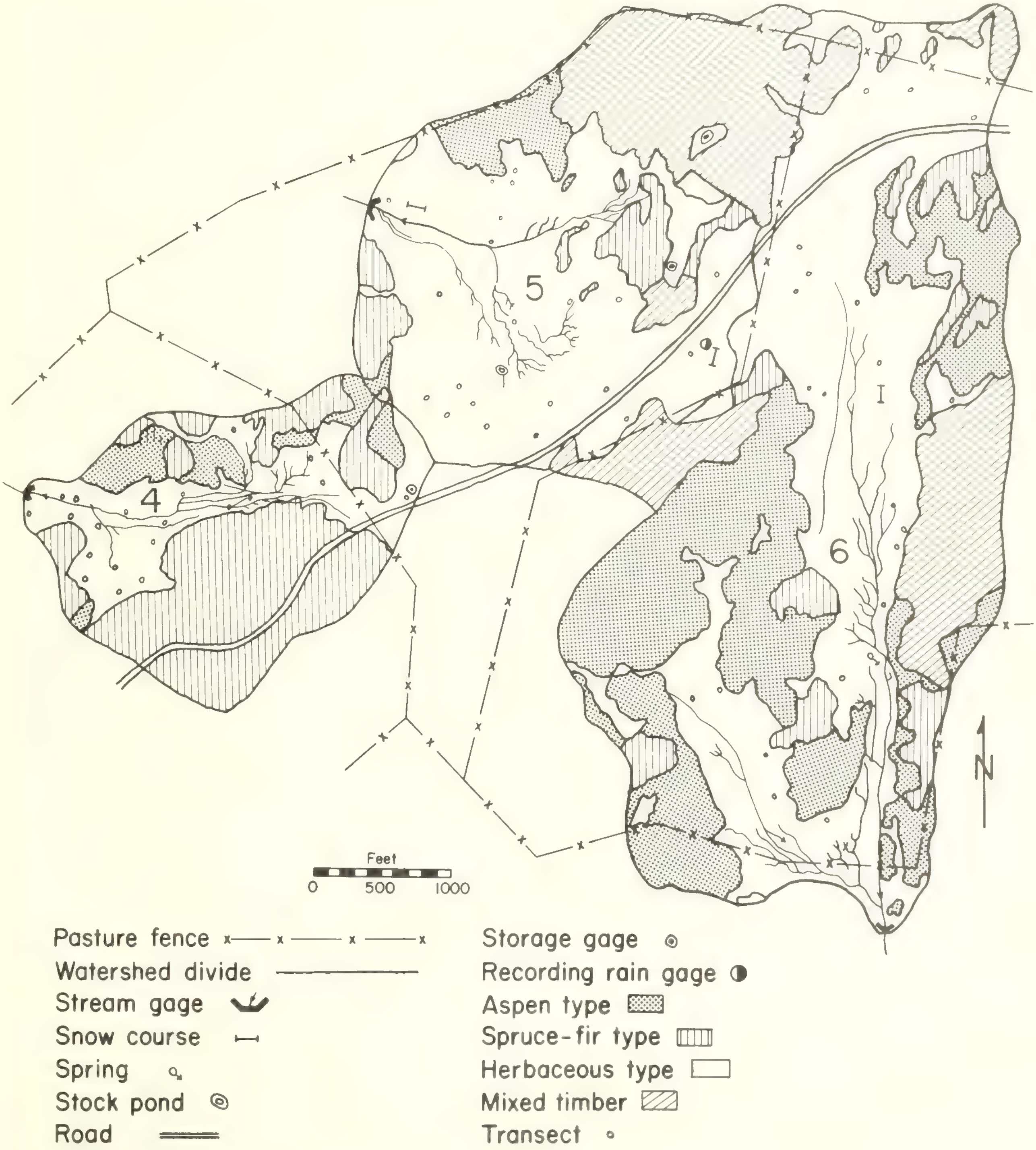

Figure 5.—Black Mesa watersheds.

estimating gage catch from snow course data, as for example, to supply an estimate for 1957 (table 3).

Typically, summer storms are thought of as heavy cloudbursts of high-intensity rain but short duration. The May-October record shows a maximum intensity of 4.56 inches per hour for a 5-minute duration. The greatest amount of rain in a 24-hour period fell in 1959, when a storm dropped 1.10 inches. The

Table 3.--Summary of annual data, Black Mesa experimental watersheds, Gunnison National Forest

Watershed and year	Precipitation[1]	Runoff	Peak discharge	Suspended sediment	Trapped sediment	Bare intercept[2]
	- - *Inches*	*- -*	*csm*	- - *lb/acre*[3]	*- -*	*No. hits*
Watershed 4						
1957	[4] 37.6	5.1	27	136	--	41
1958	34.5	4.0	21	64	--	45
1959	17.2	.2	8	54	313	30
1960	21.1	2.2	18	24	128	--
1961	15.8	.2	8	12	70	--
1962	23.0	.9	16	154	145	31
1963	15.5	.1	6	3	10	30
1964	18.5	1.2	20	57	124	26
1965	23.0	1.0	15	25	66	24
1966	17.2	.7	13	55	3	17
1967	16.4	.01	2	1	70	18
Mean ± standard deviation	21.8±7.2	1.4±1.6	14±7	53±48	103±88	29±9
Watershed 5						
1957	[4] 37.6	8.2	36	82	--	--
1958	34.5	5.9	37	75	--	61
1959	17.2	1.4	26	62	134	47
1960	21.1	5.2	[5] 96	68	53	--
1961	15.8	1.2	28	43	26	--
1962	23.0	2.6	[5] 83	56	20	42
1963	15.5	.8	[5] 52	71	6	40
1964	18.6	3.3	[5] 106	116	28	41
1965	24.1	3.0	28	17	11	39
1966	20.2	2.5	[5] 139	103	3	36
1967	16.4	.3	22	11	30	35
Mean ± standard deviation	22.2±7.1	3.1±2.3	59±8	64±30	34±38	43±8
Watershed 6						
1956	--	4.8	12	--	--	40
1957	[4] 41.2	16.2	27	99	--	--
1958	34.8	13.0	22	84	--	56
1959	19.0	3.3	10	49	92	36
1960	22.6	6.2	25	218	184	41
1961	15.9	3.3	7	29	40	30
1962	25.5	7.9	15	110	108	38
1963	17.9	1.7	5	10	42	25
1964	19.5	6.2	19	203	190	31
1965	26.4	8.6	18	107	128	34
1966	22.2	6.3	14	83	34	27
1967	19.1	2.0	4	13	12	25
Mean ± standard deviation	24.0±7.4	6.8±4.2	15±7	91±66	92±62	35±9

[1] Storage gage + standard gage no. 1 during runoff period.
[2] Mean of 20 transects/watershed.
[3] Acres in herbaceous type only.
[4] Snow course data + standard gage no. 1.
[5] Peak associated with slush flood.

maximum rainfall intensities for the period 1957-67 are:

Interval (*minutes*)	**Intensity** (*inches per hour*)
5	4.56
10	3.00
15	2.16
30	1.10
60	.68
120	.36

A much longer record kept at the Knott Ranch from 1920-45 puts the maximum 24-hour precipitation at 1.52 inches. The Knott Ranch record of summer precipitation may be extended back to 1900 (when the gage was at a different location), if a 70 percent reliability is accepted. Fitting the 1900-45 record to Gumbel's extreme value function, gives a 120-year return period for a 24-hour rainfall of 2 inches.

Runoff and Water Budget

Runoff data were obtained from FW-1 recorders on 90° V-notch weirs for each watershed. Total snowmelt runoff averaged 1.4, 3.1, and 6.8 inches on watersheds 4, 5, and 6, respectively, and 26, 14, and 28 percent of percipitation (table 3).

Some insight into the hydrologic behavior of the watersheds can be provided by calculating their water budgets for the water year 1958, using the soil moisture data reported by Brown and Thompson (1965). Average moisture storage in the upper 8 feet of soil was calculated for each watershed in the fall of 1957 and in the spring and fall of 1958.

The water budgets, in inches, were expressed as $P - RO - ET - DS - = \Delta S$, where:

P = water year precipitation
RO = runoff
ET = evapotranspiration (loss of soil moisture between spring and fall, plus summer precipitation)
DS = deep seepage, calculated as a residual
ΔS = change in soil moisture storage between fall 1957 and fall 1958

Watershed	P	- RO	- ET	- DS	= ΔS
4	34.5	4.0	13.9	17.8	-1.2
5	34.5	5.9	12.9	16.3	-0.6
6	34.8	13.0	15.4	8.1	-1.7

The most striking difference occurs between watershed 6 versus 4 and 5 in deep seepage. Precipitation was similar at the storage gages on the three watersheds, and evapotranspiration varied no more than 2.6 inches. Deep seepage, which varied as much as 9 inches between watersheds with a corresponding difference in runoff, may be attributed to the morphometry (form) of the watersheds. With runoff largely a subsurface phenomenon here, it would be logical to expect the more deeply incised watersheds to have the most runoff, because they would tend to intercept more aquifers. Indicators of the magnitude of incision are (1) the vertical rise along the longitudinal axis of the watershed, and (2) the rise laterally from points within the channel to the divide on either side:

Watershed	**Longitudinal rise** (*ft*)	**Average lateral rise**[2] (*ft*)
4	110	25
5	100	35
6	260	58

It can be seen that watershed 6, which had the greatest amount of runoff, also had the greatest longitudinal and lateral rise.

Yamamoto and Orr (1972) found that maximum basin length was consistently associated with annual water yield. Basin lengths for the three watersheds are:

Watershed	**Maximum basin length** (*ft*)
4	2,960
5	3,530
6	6,880

Again, the watershed with the greatest runoff also had the greatest maximum basin length.

By using average lateral rise (*LR*) and precipitation (*P*) as independent variables, and combining the data from all watersheds, we obtain the following multiple regression for predicting runoff (*RO*):

$$RO = -9.81 + 0.362\,(P) + 0.137\,(LR)$$
$$R^2 = 0.854$$

In summary, it appears that the amount of runoff on Black Mesa is a function of maximum basin length and degree of channel incision, as well as precipitation.

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[2] *Average of three cross sections at the lower, middle, and upper portions of the watershed from U.S.G.S. 7½' Ranch Quadrangle.*

Differences in total water yield, however (the sum of runoff plus deep seepage) are minor:

Watershed	**Total water yield** (*inches*)
4	21.8
5	22.2
6	21.1

Instantaneous peak discharge averaged 4 cubic feet per second per square mile (csm) at gage 4, 15 csm at gage 6, and 59 csm at gage 5 (table 3). The higher peaks from watershed 5 are due to the movement of a mass of water and slush down the channel caused by snow-dam failure in the main channel. The high discharges of 50 to 140 csm are due not only to the flood wave, but also to resistance of the water-slush mixture passing through the weir ponds. As many as three slush floods have occurred on successive days.

Sediment

Suspended Sediment

A weighted discharge sample was obtained using a DH-48 hand sampler upstream from the stream gage. During spring snowmelt, most samples were taken at 1- to 2-hour intervals between 8 a.m. and 5 p.m. Because sediment weight per sample was obtained by evaporating the sample to dryness, it includes not only the ovendry weight of soil, but also the dissolved solids remaining as a residue. Suspended sediment yields were estimated by averaging instantaneous sediment discharge values and multiplying by the time interval between samples. Total yield was obtained by summing these values for the period of snowmelt runoff. Thus, snowmelt sediment is biased low because (1) sampling is not carried out around the clock, and (2) with stage below the V-notch, sediment discharge is computed as zero. This bias is not thought to be large, however, because it was commonly observed that streams cleared markedly in the hours toward evening, and water levels dropped below the V-notch only on watersheds 4 and 5 during the night. In 1967, sediment samples were taken in the evening and early morning at gage 6. Sediment production amounted to 0.4 to 0.8 lb/acre/day. Duration of runoff has ranged from 2 to 10 weeks, which adds from 28 to 56 lb/acre to the annual totals on watershed 6.

Suspended sediment yields have averaged 53, 64, and 91 lb/acre of herbaceous type on watersheds 4, 5, and 6. Timber acreage was omitted from the per-acre calculation because soil disturbance in the spruce type is negligible. In aspen, the bare intercept from transect data is one-third that in the grassland type, and melt runoff is nearing completion by the time snowmelt in the timber exposes patches of bare soil to overland flow. Average sediment yields based on total area are 18, 37, and 43 lb/acre for watersheds 4, 5, and 6.

The slush floods at watershed 5 transport from 6 percent to 24 percent of the annual suspended sediment yield. After the flood wave passes, the snow close to the channel above and below the gage is covered with sediment (fig. 6). Thus the floods make sediment available to subsequent flow which might otherwise have remained on the watershed, had it not been moved near the main channel.

Trapped Sediment

Measurement of sediment trapped by the stream gages began in 1959 after the backfill around the weir ponds stabilized. Depth of wet sediment was measured, and bulk density samples were taken each year. Bulk density averaged 0.85 g/cm^3 (53 lb/ft^3) for all gages averaged for 8 years. Organic matter (as loss upon ignition at 550°C) ranged from 8 to 14 percent for samples taken in 1959 and 1960. Mean trapped sediment for the 1959-67 period amounted to 103, 34, and 92 lb/acre of herbaceous type for watersheds 4, 5, and 6, respectively. Adding these amounts to suspended sediment yields sets total production from watershed 4 at 146 lb/acre/year, 5 at 95 lb/acre/year, and 6 at 184 lb/acre/year.

Summer-Storm Sediment

During the 11 years of record at Black Mesa, a total of 167 storms occurred, with precipitation

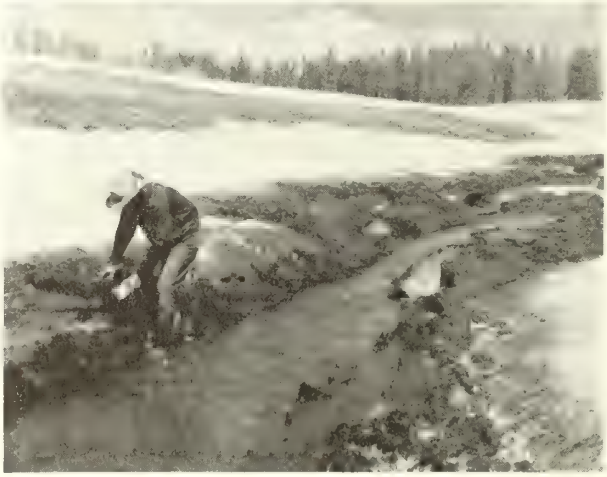

Figure 6.—Sediment after slush flood.

amounting to 0.1 inch or more. The amount of runoff from all storms during the summer averages less than 0.08 inch. Twenty-seven storms which produced runoff have been sampled for sediment. To estimate the sediment yields for the numerous storms which were not sampled, peak discharge for each runoff event was plotted against suspended-sediment yield, and an envelope curve was drawn through the maximum values. This curve was then used to estimate sediment yield for all runoff events in summer. Maximum sediment yield for any one summer was 20 lb/acre of herbaceous type, with a mean yield of 11 lb/acre.

PLANT AND GROUND-COVER CHARACTERISTICS

Plant and ground cover were measured on 20 permanent 50-ft line transects per watershed to detect changes with time. Observations were made at 6-inch intervals by dropping a ¾-inch loop. Until 1965, transects were run with bare soil, rock, litter, moss, perennial plants (by species), annuals, and overstory shrubs being recorded when encountered within the loop. In 1965, the detailed listing of each species was abandoned in favor of listing bare soil, gopher cast or mound, litter, rock, grass, forb, or shrub. Gopher activity not still identifiable as cast or mound was considered bare soil. After 1965, the transects were run three times per year: first before the cattle were put on pastures; again during late July or August, when the pre-1965 transects were run; and the third in the fall after the current year's crop of gophers had moved out to establish their own burrow systems.

Because the primary thrust of the study was to test for relationships between hydrologic variables and transect data, number of bare soil hits was the "ground-cover" variable chosen for analysis. Aside from infrequent hits on rock, bare soil hits are the complement of ground-cover index. The variable is termed bare intercept because it is only an index of bare soil on the watersheds.

Each of the watersheds is part of a larger pasture (see fig. 5), within which grazing intensity was regulated from 1957 to 1967. Pasture 4 was designated as light intensity, 5 as heavy, and 6 as moderate. The grazing intensity was adjusted to obtain 25, 40, and 60 percent utilization of Idaho fescue (*Festuca idahoensis*). Analysis of year-to-year bare intercept changes reveals a trend with time. On watershed 4, there has been a linear decrease in the total number of bare hits, while on 5 and 6, the decrease fits a power function (fig. 7).

Hits on gopher casts have been most numerous in spring and drop markedly when the same transects are run in fall, corroborating what has been readily observable over the years. During spring runoff, the watersheds appear to have been haphazardly plowed as the gopher casts settle out of the snow tunnels, but by late summer, cattle trampling and rainfall have obliterated most casts. Total number of hits on gopher mounds increases between spring and fall, but the increase is not as marked as the decrease in cast hits. Hits on gopher casts peaked in the spring of 1966, as did mounds in the fall of 1966 on watersheds 4 and 5. On watershed 6, fall of 1967 had the highest total hits on gopher mounds.

DISCUSSION

Predicting Streamflow

Correlation analyses using either peak snowpack or storage gage precipitation measurement yield coefficients which are highly significant (table 4). The standard error of estimate for the regression is improved 0.4 inch (about 6 percent of the mean) for watershed 6, with peak snowpack as the independent variable instead of storage gage precipitation. No important changes in regression parameters are evident for the other watersheds.

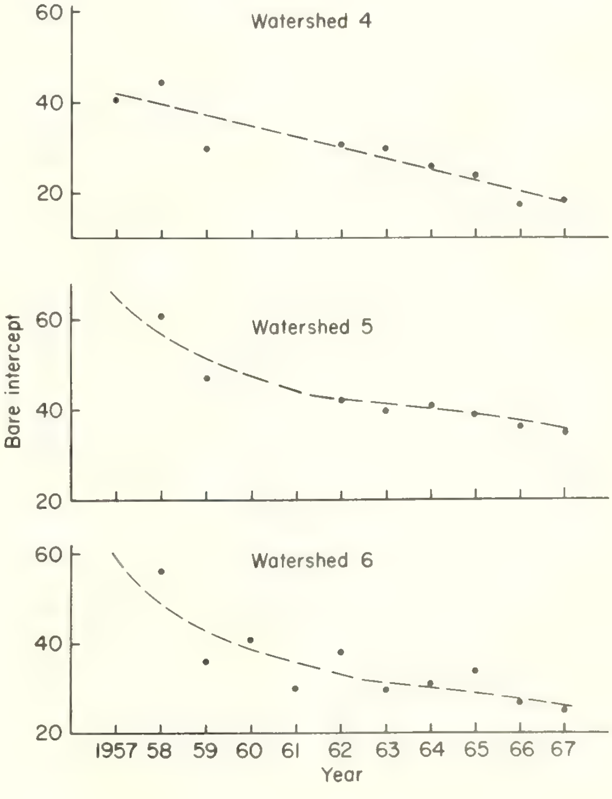

Figure 7.—Bare intercept trend.

Table 4.--Precipitation-runoff analysis by watershed and method of measuring precipitation, Black Mesa experimental watersheds, Gunnison National Forest

Watershed and measuring method	Correlation coefficient	Standard error of estimate	Regression equation
		Inches	
Watershed 4			
Gage or	0.97**	0.5	Y = 0.22X - 3.5
Course		.6	Y = 0.20X - 3.0
Watershed 5			
Gage or	.95**	1.0	Y = 0.20X - 3.0
Course		1.0	Y = 0.28X - 3.0
Watershed 6			
Gage or	.98**	1.2	Y = 0.57X - 6.9
Course		.8	Y = 0.55X - 6.1

** Significant at 1 percent level.

Predicting Sediment Yield

The attempt to define a relationship between sediment yield and bare intercept on the total watershed was not successful.

Comparison of bare intercept with suspended sediment yields does not show any large difference between sediment yield in 1958, the year bare intercept was greatest, and other years. Scatter diagrams of sediment versus bare intercept do not indicate any simple relationship which might be tested by correlation analysis.

On the assumption that bare intercept changes could influence the slope of the sediment rating curves due to the streams being able to transport as much load as is delivered to them, covariance analyses were run with the rating curve data for watersheds 4, 5, and 6. The slopes of the rating curves are significantly different for watersheds 5 and 6, while for watershed 4 the slopes are not significantly different at the 5 percent level. If the slopes of the sediment rating curves are plotted for those years that have intercept data available, no trend similar to that found with the transect data is discernible. On watershed 4, comparison of Y-intercept values for the same years as transect data also fails to show any trend. Trapped sediment was highest on watersheds 4 and 5 in 1959, the first year of measurement after allowing 2 years for backfill stabilization. Because transects are measured after spring runoff, the 1958 transect data might logically be related to the 1959 sediment production. This correspondence is the only agreement between bare soil index and sediment production. Subsequent years do not show any further agreement in comparisons within or between watersheds.

Sediment Sources

Sediment yields from the watersheds are small. If the mean annual suspended sediment loss is spread uniformly over the herbaceous type, this sediment loss can be accounted for by removal of a 0.0001-inch depth per year on each of the watersheds (assuming a sediment density of 2.65 g/cm^3). Including trapped sediment adds 0.0002-inch depth per year.

If the significant correlation between sediment discharge and stream discharge is interpreted in classical terms, another place to look for the sediment source is the stream channels. Assuming a wetted perimeter of 1 lineal ft of channel subject to erosion, downcutting of the channels by 0.02, 0.06, and 0.05 inch per year would also account for the mean annual suspended sediment yield of watersheds 4, 5, and 6, respectively. Adding trapped sediment increases the amount removed by 0.06 inch per year on each watershed.

Gopher activity—throwing up new mounds in fall and filling tunnels in the snow with soil during winter—is another source. Where loose soil from mounds or winter casts is in the path of overland flow, the soil is washed out (fig. 8). Probably all suspected sources contribute to the total suspended-sediment load; however, the small loss could be from a few specific areas where soil is readily available to be transported.

SUMMARY

Average values for the years 1957 to 1967 show better than two-thirds of the water-year precipitation is received between October and May. Ninety-nine percent of total yearly runoff and 89 percent of suspended sediment are measured during spring snowmelt. Summer storms are not severe, with only 5-minute rainfall intensities approaching the design storms of infiltrometer experiments. While suspended-sediment concentration after summer storms can be as much as six times that sampled during snowmelt, total suspended sediment production averages 91 lb/acre from spring runoff and 11 lb/acre from summer storm runoff because of the low storm runoff volume.

Regression analyses of the 11 years of data do not show any relationship between bare soil intercept and water yield or sediment production. Runoff is highly correlated with precipitation on individual watersheds. When data from the three watersheds are pooled for multiple regression analysis, runoff appears to be related to maximum basin length and degree of channel incision as well as precipitation.

Ground cover increased during the study period, even under the heaviest grazing intensity (55 percent

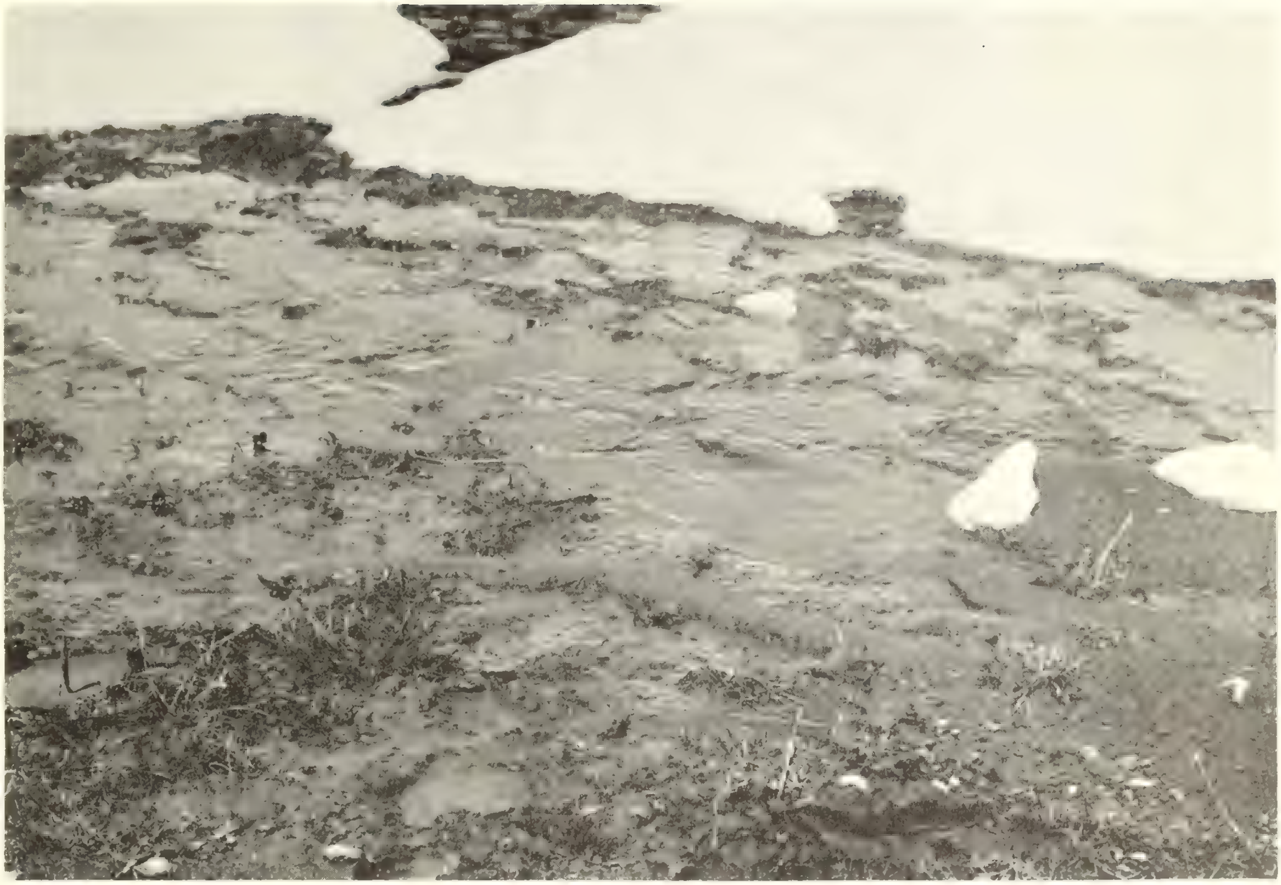

Figure 8.—Washing of gopher casts.

utilization). While the 1959 trapped and total sediment yields on watersheds 4 and 5 were maximums and might be attributed to the maximum bare intercepts recorded in 1958, subsequent years and watershed 6 do not indicate any further correspondence between these variables, either within or between watersheds.

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The help and cooperation of the Black Mesa Cooperative Cattlemen's Association, Maher, Colorado, is gratefully acknowledged.

LITERATURE CITED

Brown, H. E., and J. R. Thompson.
1965. Summer water use by aspen, spruce, and grassland in western Colorado. J. For. 63:756-760.
Packer, P. E.
1951. An approach to watershed protection criteria. J. For. 49:639-644.
Paulsen, Harold A., Jr.
1969. Forage values on a mountain grassland-aspen range in western Colorado. J. Range Manage. 22:102-107.
Turner, George T., and Edward J. Dortignac.
1954. Infiltration, erosion, and herbage production on some mountain grasslands in western Colorado. J. For. 52:858-860.
U.S. Department of Agriculture. Forest Service.
1948. Annual Report. U.S. Dep. Agric., For. Serv., Intermt. For. and Range Exp. Stn. 70 p., Ogden, Utah.
Yamamoto, Teruo, and Howard K. Orr.
1972. Morphometry of three small watersheds, Black Hills, South Dakota, and some hydrologic implications. USDA For. Serv. Res. Pap. RM-93, 15 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Agriculture—CSU, Ft. Collins

Frank, Ernest C., Harry E. Brown, and J. R. Thompson.
1975. Hydrology of Black Mesa watersheds, western Colorado. USDA For. Serv. Gen. Tech. Rep. RM-13, 11 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Eleven years of runoff and suspended sediment data show no relationship to bare soil intercept. This lack of relationship is probably due to the experimental error in measuring these small amounts of sediment. Bare intercept decreased on each watershed during the 1957-67 period even though grazing utilized an average of 40 percent of the grass in the open parks on one of the watersheds.

While suspended-sediment concentration after summer storms can be as much as six times that sampled during snowmelt, total yield averages 91 lb/acre from spring runoff and 11 lb/acre from storm runoff because of the small volume of flow. Based on current erosion classification schemes, these are very minor amounts of "geologic erosion."

Keywords: Hydrology, runoff, suspended sediment, Black Mesa watershed.

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88 RM-14

Wildland Fires and Dwarf Mistletoes: A Literature Review of Ecology and Prescribed Burning

Martin E. Alexander and
Frank G. Hawksworth

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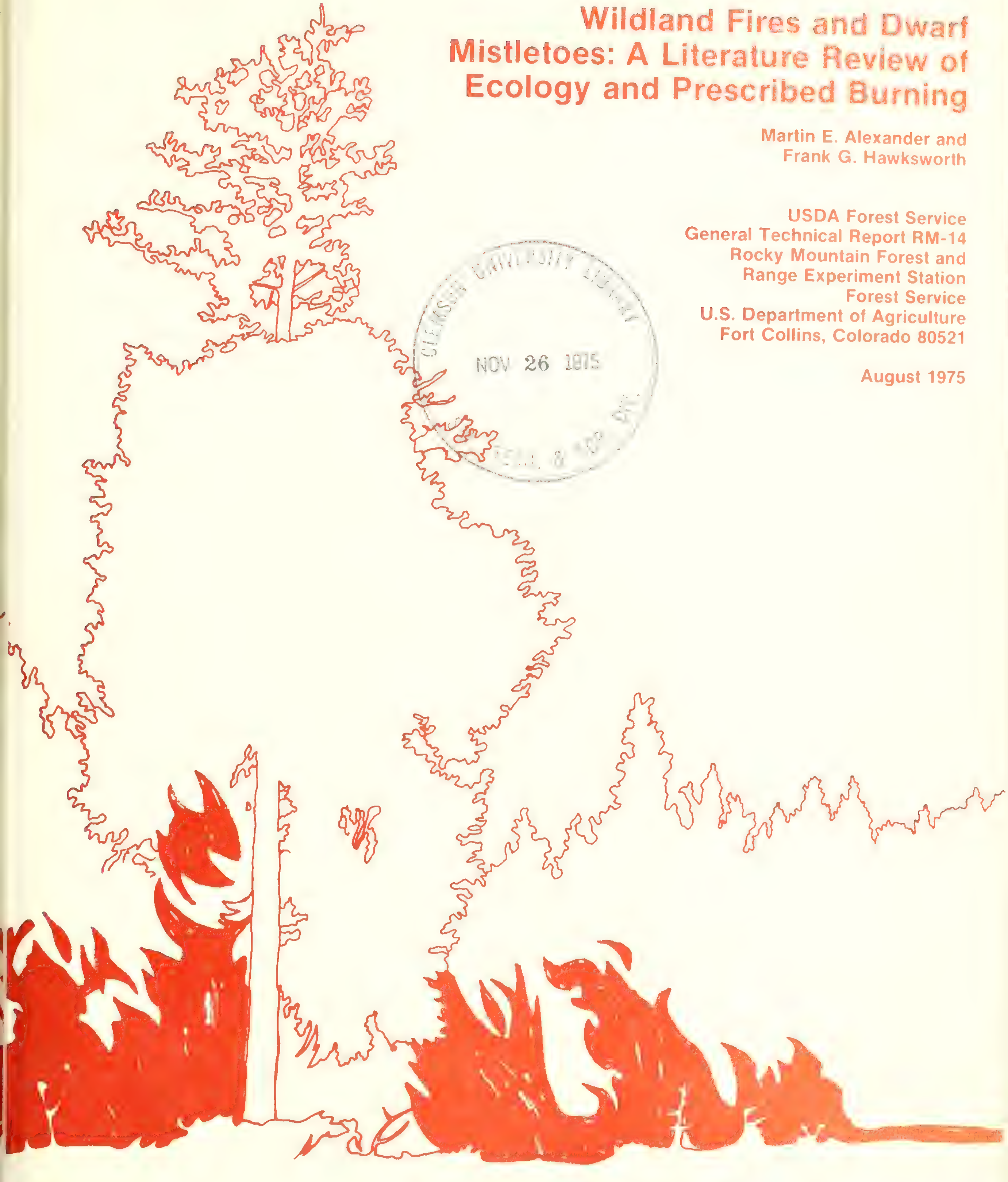

Abstract

Alexander, Martin E., and Frank G. Hawksworth.
1975. Wildland fires and dwarf mistletoes: A literature review of ecology and prescribed burning. USDA For. Serv. Gen. Tech. Rep. RM-14, 12 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521

Wildfires play a multiple role in the distribution of dwarf mistletoes — they may either inhibit or encourage these parasites depending primarily on the size and intensity of the burn. Many reports suggest that fire exclusion policies of the past half century have resulted in increased dwarf mistletoe levels as well as increased fire behavior potential. Prescribed burning as a supplemental method of dwarf mistletoe control has been little used, but seems to be applicable in some forest types and stand conditions both to eliminate infected residuals in cutover areas and to eliminate heavily infested unmerchantable stands. Suggested areas of research relating to fire ecology and prescribed burning are given.

Keywords: *Arceuthobium,* wildfires, prescribed burning, fire ecology.

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Wildland Fires and Dwarf Mistletoes: A Literature Review of Ecology and Prescribed Burning

Martin E. Alexander, Forestry Technician
and
Frank G. Hawksworth, Principal Plant Pathologist

Rocky Mountain Forest and Range Experiment Station[1]

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[1] *Central headquarters is maintained at Fort Collins, in cooperation with Colorado State University. Alexander was with the Station's National Fire-Danger Rating Research Work Unit when the work was done; he is now Graduate Research Assistant, Fire Science Program, Department of Forest and Wood Sciences, Colorado State University, Fort Collins.*

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WILDLAND FIRES AND DWARF MISTLETOES:
A Literature Review of Ecology and Prescribed Burning

Martin E. Alexander and Frank G. Hawksworth

Introduction

Although wildfire is probably the primary factor governing the distribution and abundance of dwarf mistletoes (*Arceuthobium* spp.), surprisingly little quantitative information on this relationship is available. Because of the increased recognition of fire as a natural ecological factor in the development and management of North American coniferous forests, we believe that it is timely to summarize the available literature on interrelationships of dwarf mistletoes and wildland fires.

Dwarf mistletoes are the most serious forest disease agents in western North American coniferous forests. Dwarf mistletoe is also the most damaging disease agent of black spruce in the Lake States. It has been estimated that the combined losses to mortality and growth reduction due to these parasites in the western United States total about 3.2 billion board feet annually (Shea and Howard 1969). Some of the most seriously damaged North American coniferous tree species are:

lodgepole pine	*Pinus contorta* Dougl.
jack pine	*P. banksiana* Lamb.
Jeffrey pine	*P. jeffreyi* Grev. & Balf.
ponderosa pine	*P. ponderosa* Laws.
sugar pine	*P. lambertiana* Dougl.
Douglas-fir	*Pseudotsuga menziesii* (Mirb.) Franco
western larch	*Larix occidentalis* Nutt.
western hemlock	*Tsuga heterophylla* (Raf.) Sarg.
white fir	*Abies concolor* (Gord. & Glend.) Lindl.
red fir	*A. magnifica* A. Murr.
black spruce	*Picea mariana* (Mill.) B.S.P.

For this Report, we have arbitrarily divided the subject into two areas — fire ecology of dwarf mistletoes and prescribed burning as a control tool. We recognize that this is an artificial separation because wildfires and prescribed fires may behave the same and have the same effects if burning conditions are similar for a given area.

Fire Ecology of Dwarf Mistletoes

Wildfires play a multiple role in the distribution of dwarf mistletoes. Fire both encourages and discourages dwarf mistletoe depending on whether we look at the long or short view (Hawksworth 1969). Relatively complete burns tend to have a sanitizing effect on infested stands, because trees typically reinvade the burned area much faster than the parasite (Jones 1974). On the other hand, partial burns that leave scattered infected trees or groups of trees throughout the stand may create ideal conditions for rapid spread of dwarf mistletoe to the young stand (Kimmey and Mielke 1959, Graham 1960, Hawksworth 1969, Muir 1970).

In British Columbia, Smith and Baranyay (1970) note that fire, which is an important agent in the destruction and establishment of coniferous forests, has acted as an effective natural control of dwarf mistletoe. In contrast, wood-harvesting and thinning of stands naturally by windthrow, insects and other diseases, combined with greatly improved fire protection, have tended to create favorable conditions for dwarf mistletoe intensification. Consequently, the disease has reached high levels in many second-growth stands.

Several effects of dwarf mistletoe parasitism, such as tree mortality, stunted trees, spike tops, witches' brooms, and resin-infiltrated stem cankers (Kimmey and Mielke 1959), tend to increase the fire behavior potential (rate of spread, intensity, crowning, spotting and duration) (Roth 1966, Jones 1974) and flammability of infested stands (fig. 1). The accumulation of dead fuels in heavily infested stands (fig. 2) also predisposes them to fires (Beaufait 1971, Heinselman 1973, Jones 1974).

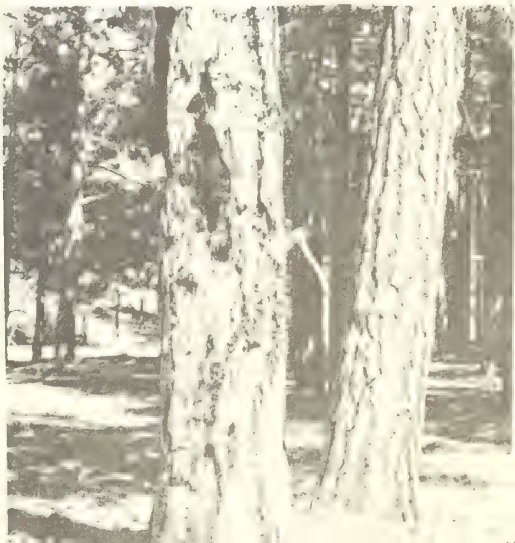

Figure 1. — This severe fire scar on a 24-inch diameter at breast height ponderosa pine resulted when a dwarf mistletoe-infected branch burned off. Such scars are common on older ponderosa pines in infested areas throughout the West. Grand Canyon National Park, Arizona (Hawksworth 1961a).

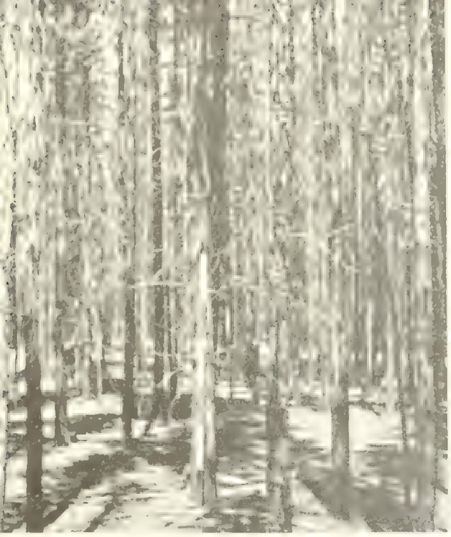

Figure 2.—Healthy (left) and dwarf mistletoe-infested (right) parts of the same 84-year-old lodgepole pine stand. Trees in the infected stand are about ⅓ as tall and half the diameter of trees in the healthy stand. Heavy accumulation of dead fuels on the ground and greater numbers of small trees with foliage near the ground increase the fire hazard in infested stands. Roosevelt National Forest, Colorado (Hawksworth and Hinds 1964).

No data are available on the temperatures lethal to dwarf mistletoe plants, or on the effects of smoke on these parasites. Parmeter and Uhrenholdt (1975) showed in laboratory tests that smoke inhibits spore germination, mycelial growth, and infection of several forest fungi, but no such studies have been conducted on the dwarf mistletoes. Smoke from wildfires might have several effects including interference with pollination, seed germination, and infection.[2]

In a broader sense, wildfires may encourage the dwarf mistletoes in certain forest regions by their conversion of nonsusceptible climax species to susceptible seral trees (Hawksworth 1969, 1975).

Because of the increased fire potential in dwarf mistletoe-infested forests, fires have played a major role in keeping these parasites in check. Lyon and Pengelly (1970) write that "within the concept of a cycling succession pattern in which fire is a vital component, it is also possible that insects and diseases are a vital component of the system — even if only in the degree that they help to increase the probability of successful fire occurrence." When vast areas are protected from fires for long periods, the mosaic of vegetation created by wildfires of varied frequency and distribution tends to be lost (Komarek 1963, Beaufait 1971).

Another possible role of wildfires is a tendency to limit development of genetic resistance to native diseases and insects (Roth 1966, Howe 1973).

Lodgepole and Jack Pines

These closely related tree species are similar ecologically, and are parasitized by the same dwarf mistletoe, *Arceuthobium americanum* Nutt. ex Engelm. Although more observations on the effects of fire have been recorded for *A. americanum* than for any other western dwarf mistletoe, little quantitative information is available.

Dowding (1929) felt that the distribution of *A. americanum* in jack pine stands in Alberta was determined principally by wildfires. Dwarf mistletoe tends to persist on the drier ridges because fires there are less intense due to the sparse undergrowth. Wildfires do not kill all the trees on such areas, and some dwarf mistletoe-infested trees survive to infect regeneration. In nearby flat areas there is much more undergrowth, so that wildfires kill essentially all trees, thus eliminating dwarf mistletoe (Dowding 1929).

The significance of wildfire in lodgepole pine forests is emphasized by Baranyay (1970): "Fire, the most important agent in the destruction and establishment of pine forests in Alberta, has acted as the only effective natural control of dwarf mistletoe." Fire has played a major role in the determination of the present mistletoe distribution patterns of lodgepole pine and its mistletoe (Gill and Hawksworth 1964). For example, Baranyay (1972) stated that dissimilarities in fire history are the primary reason why there is much more dwarf mistletoe in lodgepole pine in the Upper Foothills and East Slope Rockies forest types than in the Lower Foothills of Alberta. In the Lower Foothills, wildfires over the last 100 years were very extensive and complete. The young lodgepole pine stands that developed in these burns are relatively free of mistletoe. In the other two forest types, however, variations in topographic and forest conditions prevented the development of large conflagrations. Many residual mistletoe-infected trees survived and infected the young stands that developed after wildfires.

Surveys in three National Forests in Colorado and Wyoming revealed that more than half of the lodgepole pine acreage was affected by dwarf mistletoe (Hawksworth 1958b). Wildfires tended to reduce dwarf mistletoe because both the area infested and degree of infestation in recently regenerated burns was less than in the adjacent virgin or partially cut stands:

---

[2] *Personal communication from J. R. Parmeter, Jr., Professor of Plant Pathology, Univ. Calif., Berkeley.*

Stand condition	Proportion of area — Infested	Heavily infested
	- - - (Percent) - - -	
Virgin	49	28
Partially cut	66	41
Regenerated burns	24	5

Lodgepole pine reproduction in clearcuts or burned areas in the northern Rocky Mountains of Idaho and Montana is generally uninfected or only lightly infected by dwarf mistletoe (LeBarron 1947, 1952). Lotan (1975) states that fire provides a self-correcting check on insects and diseases, and cites the lodgepole pine area burned by the large Sleeping Child fire in Montana which will be relatively free of mountain pine beetle *(Dendroctonus ponderosae)* and dwarf mistletoe for decades. Similarly, Taylor (1969) found that infection in regenerated lodgepole pine burns in Yellowstone National Park was relatively low. Dwarf mistletoe incidence was directly correlated with time since the burn:

Years since burn	Proportion of lodgepole pines infected
	- - - (Percent) - - -
7	0
13	0
25	0
57	1
111	10
ca. 300	36

Lodgepole pine dwarf mistletoe is more common on ridge and slope sites than in bottom sites (Hawksworth 1958b). This is presumably due, at least in part, to different intensities of wildfires and tree survival at the different sites.

Hawksworth (1958a) showed that spread of dwarf mistletoe from unburned mature stands into reproduction on adjacent sites was relatively slow and averaged only about 1 to 2 feet per year (fig. 3).

Immature dwarf mistletoe-infested lodgepole pine stands have much more dead material on the ground, more stems, and more foliage near the ground than comparable uninfested stands (Hawkworth and Hinds 1964) (see fig. 2). Brown (1975) summarized the many related factors that influence fire cycles in lodgepole pine forests (fig. 4). He stated that dwarf mistletoe often adds to the ground fuel and also that witches' brooms enhance vertical fuel continuity and thus increase the likelihood of ground fuels creating a "fire ladder" to burn out individual tree crowns. The witches' brooms also tend to trap fallen needles, thus increasing the scattering of vertically situated fine fuels which are ideally situated for optimal fire flammability.

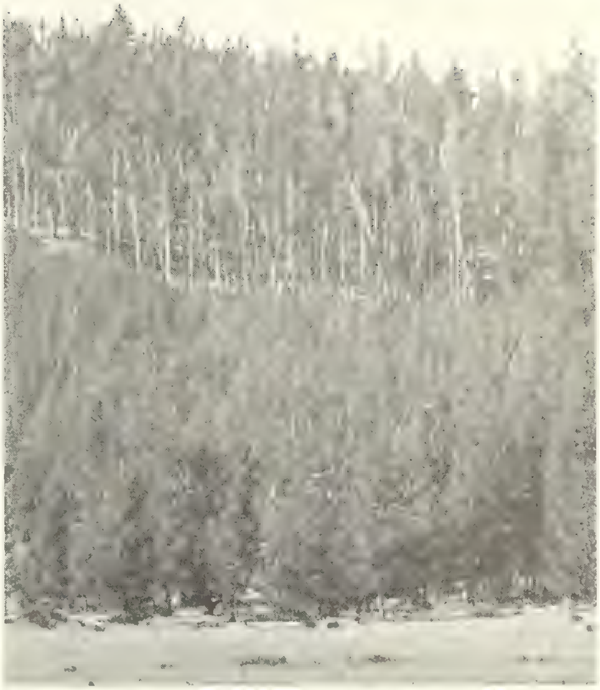

Figure 3. — A 48-year-old lodgepole pine stand (foreground) that developed after a fire. Note the abrupt line between the young stand and the overmature stand in the background. The older stand is heavily infected by dwarf mistletoe, but the parasite has only progressed 73 feet into the young stand. Bighorn National Forest, Wyoming (Hawksworth 1958a).

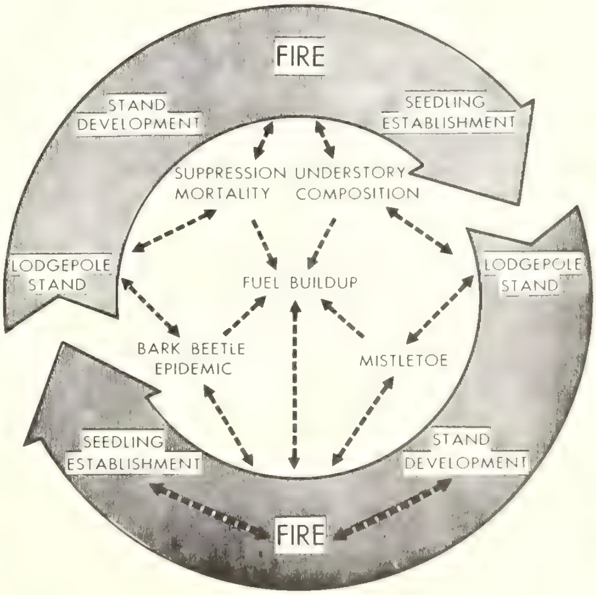

Figure 4. — The many related factors influencing the fire cycle in lodgepole pine forests (Brown 1975).

In a broad sense, wildfires may tend to increase certain mistletoe-susceptible seral tree species, such as lodgepole pine and jack pine. For example, the climax spruce-fir *(Picea engelmannii* Parry-*Abies lasiocarpa* (Hook.) Nutt.) forests of the Rocky Mountains are generally resistant to dwarf mistletoes; the seral lodgepole pine, which frequently replaces spruce-fir in burned sites, is very susceptible (Kuijt 1955, Hawksworth 1975). Whether or not mistletoe increases in the seral stand, however, depends on the availability of infection sources. If no infected lodgepole pines occur in the area, the young lodgepole pine stands will remain free of dwarf mistletoe. An important role of fires in relation to succession seems to be the maintenance of seral stands by intermittent fire so that dwarf mistletoe seed sources are not eliminated and the climax stands of nonsusceptible tree species are not able to develop.

Many authors have suggested that control of wildfires over the past few decades has resulted in an increase in dwarf mistletoe in lodgepole pine forests (Kimmey 1957; Baranyay 1970, 1975; Heinselman 1970; Smith and Baranyay 1970; Loope 1971; Frykman 1972; Hawksworth 1975).

Ponderosa Pine

Although fire has been an integral ecological factor in the development of ponderosa pine stands, relatively little information is available on the effects of fire on abundance and intensity of dwarf mistletoes. Ponderosa pine is parasitized primarily by two species of dwarf mistletoe — *Arceuthobium campylopodum* Engelm. from California to Washington and Idaho, and *A. vaginatum* subsp. *cryptopodum* (Engelm.) Hawksw. & Wiens from Utah and Colorado south to northern Mexico (Hawksworth and Wiens 1972).

The characteristically spotty distribution of both dwarf mistletoes is due in large part to fire history (Roth 1953, 1954; Andrews 1957; Hawksworth 1961a, 1961b; Jones 1974). For example, Roth (1953) studied *A. campylopodum* on part of the Pringle Falls Experimental Forest, Oregon, and found that no mistletoe occurred in a 40-acre even-aged stand of young ponderosa pine established after a fire, except where infection had spread from eight infected old-growth trees that had survived the fire. The effect of fire in eliminating mistletoe and enabling regeneration of a healthy forest was clearly demonstrated since a large part of the original stand was apparently heavily infected.

According to Roth (1974a, 1974b), before fires were controlled in Oregon ponderosa pine stands, heat from repeated ground fires pruned back mistletoe-infected branches in the lower crowns, thus limiting the mistletoe plants to a sometimes inconspicuous presence high in the forest canopy. With the coming of fire control and timber harvest, the forest floor has become occupied by stands of pine saplings, usually dense, which offer a good start on production of the next forest crop. However, in the mistletoe patches these saplings often become heavily infected.

In the Southwest, ponderosa pine dwarf mistletoe occurs most frequently on ridges, less frequently on slopes, and least in bottom sites (Hawksworth 1959, Andrews and Daniels 1960). Although the factors governing these relationships are not known, it is likely that fire history is involved.

Although we have little direct evidence, it appears that dwarf mistletoe in ponderosa pine in the Southwest, and perhaps elsewhere, has increased in the last few decades. Many virgin ponderosa pine stands typically consisted of widely spaced mature trees with a generally luxuriant grass understory (Cooper 1960; Weaver 1967a, 1967b). Young trees were occasionally scattered in groups through the stands. Fires occurred at 4- to 7-year intervals (Cooper 1960, Biswell et al. 1973, Weaver 1974), but were essentially confined to the grass understory with little direct effect on the trees. With the advent of aggressive fire control policies, dense young pine stands have been allowed to develop. These have become infected by dwarf mistletoe from the remaining overstory trees in many areas. These young stands also offer serious competition to the overstory stands, and in many areas of the Southwest the overstory stands are rapidly declining (Hawksworth and Lusher 1956).

Shields,[3] a forester on the Mescalero-Apache Indian Reservation in southern New Mexico from the mid-1920's to the mid-1950's observed changes in the ponderosa pine type in the Reservation following the adoption of a fire exclusion policy at about the turn of the century. He believed that the pine stands were formerly open with very sparse reproduction. Fire exclusion led to the development of extensive reproduction, and most stands on the Reservation became two-aged. This resulted in ideal conditions for maximum spread of dwarf mistletoe, and the parasite became much more abundant than in the former, predominately single-storied, stands.

Observations by Hawksworth (1968) in ponderosa pine stands still subject to periodic fires (for example, in the Malay Gap area, San Carlos Indian Reservation, Arizona, and in the Sierra Madre Occidental in Chihuahua, Mexico) also suggest that the stand structure is different, and that dwarf mistletoe is generally less common than in stands protected from wildfires.

Roth (1966) presents an interesting hypothesis to explain why ponderosa pine has apparently not been able to develop natural resistance to dwarf mistletoe *(A. campylopodum)*. He suggests that the answer may lie in the fire ecology of the host:

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[3] *Shields, Bert. 1953. Mistletoe on the Mescalero Indian Reservation. U.S. Dep. Int., Bureau of Indian Affairs. Unpublished report on file at the Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.*

> Recall that while selective pressure may be great within a mistletoe infection center, the centers, however large, are dispersed and, because of limitations on spread imposed by the heavy seed of the mistletoe are, for the most part, surrounded by healthy pines not subject to selection pressure. The ponderosa pine forest type historically is characterized by repeated burning by ground fires. However, because of the large amount of fuel on and near the ground where mistletoe is present, chiefly in the form of fallen witches' brooms, brooms near the ground, and dead trees, these normally nondestructive wildfires formerly, upon burning into centers of mistletoe infestation, frequently become conflagrations destroying not only heavily infected trees of the stand, but also any resistant individuals that may have been selected. Seed establishing a new stand on the burned area came not from trees in process of selection toward resistance, but rather from the surrounding forest of susceptible trees.

Douglas-fir

Douglas-fir is severely parasitized by dwarf mistletoe *(Arceuthobium douglasii* Engelm.) throughout most of its range (Hawksworth and Wiens 1972). As with most other western conifers, wildfires have played an important role in the distribution of Douglas-fir and its dwarf mistletoe (Graham 1961). The "patchy" distribution of dwarf mistletoe is due, in large part, to fire history (Tinnin and Knutson 1973).

Weir (1916b) noted that the large, dense witches' brooms caused by dwarf mistletoe in Douglas-fir are often broken from the trees during snowstorms. These accumulate around the bases of the trees and increase the likelihood of "torch outs" from ground fires.

Boyce (1961) pointed out that, once stands infected by dwarf mistletoe are logged, the heavy witches' brooms increase the fire hazard in the logging slash. The branches with brooms, because of the abnormal amounts of compression wood and resin, are more resistant to decay than normal branches, thus maintaining a fire hazard for a longer period of time. Also, large brooms on living or dead standing trees may promote crown fires and spot fires.

Spot fires, caused predominately by large witches' brooms, were very noticeable on a prescribed fire (Lyon 1971) observed by Lancaster.[4] Flaming witches' brooms 2 to 3 feet in diameter were carried aloft in the convection column, fell, and caused spot fires from 6 to 8 chains outside the control lines. The dense, heavy witches' brooms "exploded" on impact with the ground and almost instantly spread flames over a 12- to 15-foot circular area. In addition, some burning brooms rolled down hillsides after landing, causing further fire spread.

Black and White Spruces

Black spruce and white spruce *(Picea glauca* (Moench) Voss) are commonly attacked by the dwarf mistletoe *Arceuthobium pusillum* Peck in the Lake States, New England, and adjacent parts of Canada (Hawksworth and Wiens 1972). Wildfire is generally agreed to be the chief factor limiting spread of dwarf mistletoe in unmanaged black spruce stands (LeBarron 1948; Anderson 1949; Beckwith and Anderson 1956; Heinselman 1957, 1970, 1973).

According to LeBarron (1948), most even-aged stands of black spruce are the result of wildfire, and dwarf mistletoe accelerates the transformation from even-aged to uneven-aged stands. Infection by dwarf mistletoe, therefore, allows for an earlier formation of uneven-aged stands. He also suggests dwarf mistletoe intensity is more severe in old stands that have not been rejuvenated by wildfire.

Anderson (1949) believed that the origin of black spruce stands after wildfire was generally the reason for the low intensity of dwarf mistletoe. He found no mistletoe in burns under 30 years old. This indicates that wildfires of sufficient intensity to kill existing stands of spruce eliminate the mistletoe but do not hinder establishment of black spruce seedlings.

Because stands killed or injured by mistletoe are very flammable, fire was apparently the natural check on dwarf mistletoe (Heinselman 1973). Dwarf mistletoe could ravage many black spruce forests on both upland sites and peatlands with continued fire protection (Anderson and Kaufert 1953, Heinselman 1973).

Heinselman (1970) states that "because of the fire exclusion policy of public and private forest protection agencies and organizations, we are seeing a vast expansion of dwarf mistletoe in forest areas, particularly on species like black spruce."

Other Coniferous Species

Parmeter and Scharpf (1963) discuss the role of fire on *Arceuthobium abietinum* Engelm. ex Munz on white fir and red fir in California. They state that wildfires have destroyed large tracts of fir, thus removing dwarf mistletoe from the stand. These large burns come back to manzanita *(Arctostaphylos* spp.), chinquapin (*Castanopsis* sp.), and similar plants that form dense brushfields. Firs are pioneer invaders of these brushfields, seeding in slowly from the margins or from islands of trees that survive the fire. Examination of areas where firs are advancing into brushfields indicates that, when stands at the margin or surviving islands of trees within the burn are infected, the advance of the mistletoe keeps pace with the advance of the fir. Thus, the stand that eventually replaces the brush is often heavily infected. These observations suggest that while fire may temporarily destroy dwarf mistletoe by destroying infected stands, the ecological sequence leading to reforestation of burns in the fir belt tends ultimately to perpetuate extensive mistletoe infection.

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[4] *Personal communication from James W. Lancaster, Principal Forester, Rocky Mt. For. and Range Exp. Stn., Boise, Idaho.*

Fire has also played an important role in the development of *Arceuthobium tsugense* (Rosendahl) G. N. Jones in western hemlock stands in the Pacific Northwest (Shea 1966, Russell 1971) and in British Columbia (Wellwood 1956). Mature stands that are essentially even-aged and of fire origin have little infection. The infections that are present are commonly found around old infected residuals that survived the fire. Decadent stands of heavily infested trees are most subject to catastrophic fires (Shea and Stewart 1972).

Fire history is also significant in the abundance of *Arceuthobium laricis* (Piper) St. John on western larch, a seral tree that is abundant in burned-over forests. The climax species in most western larch areas in the Inland Empire are *Thuja plicata* Donn and *Tsuga heterophylla,* neither of which are parasitized by dwarf mistletoe there. Thus we have a parallel situation to lodgepole pine forests where a seral tree species is severely parasitized but the climax species are not. Mature western larches have thick, fire-resistant bark so many trees survive and provide loci of infection after wildfires burn through infested mature stands. Larch trees are usually not components of advanced regeneration but they are frequently left as overstory residuals after selective logging or wildfires. Such areas, even if only lightly infected, will become an important source of inoculum for larch reproduction that becomes established near them (Smith 1966).

The presumed role of natural fires in controlling *Arceuthobium occidentale* Engelm. in digger pine *(Pinus sabiniana* Dougl.) in the California foothills is mentioned by Webb (1971).

Prescribed Burning as a Control Tool

Traditionally, dwarf mistletoe control has been attempted through silvicultural treatments such as removal of infected trees from regeneration areas, pruning, and clearcutting. Prescribed burning as a supplemental method of control has been little used, but would seem to be applicable in some forest types and situations. Prescribed burning might serve two purposes: (1) provide a cheap and effective means of eliminating infected residual trees in logged-over areas, and (2) destroy infected stands in areas where dwarf mistletoe has rendered stands unmerchantable so that they can be replaced with healthy young stands.

The use of fire as a forest management tool for controlling dwarf mistletoes was first advocated nearly 60 years ago by Weir (1916a, 1916b). Gill and Hawksworth (1961) and Smith (1971) discussed the use of prescribed burning as a supplemental control measure for dwarf mistletoes. In a general paper on control of dwarf mistletoes in the Intermountain and Northern Rocky Mountain Regions, Kimmey and Graham (1960) state that "Stands of a single species, under heavy infection conditions, are best treated by clearcutting. Any advanced reproduction or other unmerchantable residual trees must then be sanitized by direct eradication, either by bulldozing or broadcast burning." Ainscough (1971) feels that burning is justified in eradication of mistletoe-infected residuals which could possibly infect the new stand and adversely affect quality and growth if rotations were extended much beyond 60 or 70 years. Baranyay and Smith (1972) find that prescribed fire effectively removes nonmerchantable infected material. Broadcast slash burning is recommended if it is silviculturally and locally acceptable. Areas with dwarf mistletoe should have priority for slash burning. After burning, however, the area should be checked for surviving infected residuals, which should be cut or poisoned. Jones (1974) feels that prescribed fire in the mixed conifer forests of the Southwest can serve as a sanitation measure following the commercial clearcutting of parts of stands where dwarf mistletoe is especially severe.

According to Pechanec (1970), prescribed burning in the northern Rocky Mountains has been used primarily for hazard reduction in logging slash areas and for seedbed preparation rather than to reduce incidence of forest tree diseases. Beaufait (1966) gives detailed instructions for prescribed burning (including mistletoe control) in the Intermountain West forests.

Lodgepole and Jack Pines

Several researchers (Kiil 1969; Baranyay 1970, 1975; Sando and Dobbs 1970) in Canada suggest that prescribed fire is a legitimate approach to mistletoe eradication of nonmerchantable infected material remaining after logging. Sando and Dobbs (1970) report that prescribed fire has not often been used for control of dwarf mistletoe in jack pine in central Canada, but there is compelling evidence that it can be used. They recommend prescribed burning as a sanitation tool to remove infected residual trees in logged areas, otherwise subsequent regeneration may be lost.

Ponderosa Pine

Weaver (1967a) stated that prescribed burning can be used in even-aged ponderosa pine management to control diseases such as dwarf mistletoe. Kimmey and Mielke (1959) suggested that, in areas so heavily infected with mistletoe that they are unmerchantable, clearcutting followed by broadcast burning was the most practical means of controlling this destructive pathogen. After the burn, the area should be replanted to establish a healthy stand.

Prescribed burning for mistletoe eradication was attempted recently in ponderosa pine on the Fremont National Forest in south-central Oregon (USDA-FS 1973). Prescribed fire was used in October 1973 for site preparation to eliminate an unsalvageable stand of young ponderosa pine heavily infected with dwarf mistletoe. Approximately 100 acres were burned to clean up residual slash from a complete overstory removal. The burning prescription was formulated to create as severe burning conditions as possible and still maintain control of the fire. The burning plan called for: (1) windspeed — 10 miles per hour; (2) relative humidity — 20 percent; (3) ½-inch fuel moisture stick content — 10 percent; (4) Action Class — greater than 3L; and (5) ignition component — 3 (Deeming et al. 1972). It was estimated that 95 percent of the unmerchantable trees were killed. Prescribed burning for mistletoe control was less expensive than traditional methods which required tree felling, dozer piling, and then burning the resultant piles. In addition, planting could be done in one season instead of over a 2- to 4-year period.

Douglas-fir

Isaac (1963) suggested that burning may be necessary to retard or destroy disease organisms such as dwarf mistletoe in heavily infested Douglas-fir stands.

Lyon (1971) described a prescribed fire in a stand seriously affected by *A. douglasii,* and the subsequent establishment of a healthy stand of Douglas-fir. The basic purpose of this prescribed burn was to attain the intensity of wildfire conditions for sanitation and site preparation. The 120-acre area was a cutover site on the Sawtooth National Forest in south central Idaho. The remaining standing timber consisted predominately of mistletoe-deformed, unmerchantable saplings and poles. After the area was burned, portions of the site were direct seeded to establish a new, healthy forest. Details on the effects of the fire on mistletoe control objectives were not given but essentially all residual overstory Douglas-firs were killed, so the mistletoe seed source was eliminated.

During the firing period the following weather parameters were observed: (1) air temperature rose from mid-50°'s to nearly 80°F, (2) relative humidity dropped from 50 percent to less than 10 percent, and (3) surfce winds were under 5 miles per hour with fire-induced gusts up to 30 miles per hour or more during the peak of the fire. Fuel moisture sticks examined at midafternoon each day during the week preceding the burn were observed to be relatively constant at 5 to 6 percent. This prescribed fire was unique from a research standpoint in that burning conditions similar to a high-intensity wildfire were attained.

Black and White Spruces

The dwarf mistletoe *Arceuthobium pusillum* is estimated to affect 3 to 11 percent of the black spruce area in Minnesota (Anderson 1949). More experimental work and practical application of prescribed burning of mistletoe has been done on black spruce than for any other species (French 1967; Irving and French 1971; Johnson 1971a, 1975).

LeBarron (1948) pointed out that dwarf mistletoe causes great damage in open-crowned spruce swamp stands. In such instances, all trees are parasitized. The only way to achieve satisfactory control would be to cut down or burn all the infected trees, including the small seedlings. Broadcast burning of the logging slash in favorable weather would also achieve the desired effect. New stands originating from seed in fire-killed stands may remain comparatively free of mistletoe for many years. LeBarron (1948) believes that dwarf mistletoe could prove more serious in managed forests where this "rejuvenating" effect of fires is absent.

Anderson (1949) felt that fire effectively eradicates mistletoe infection, but its use is impractical because of (1) the lack of information on conditions "just right" to get a burn of the desired intensity, (2) the element of risk involved in building and holding firelines on large spruce swamps, and (3) the "aversion" of northern foresters to the use of prescribed burning because of the risk involved and public relations.

Policies and attitudes have changed since the late 1940's, however, and now several thousand acres are prescription burned in the Lake States annually (Donoghue and Johnson 1975). Although mistletoe control is one of the objectives in prescribed burning in black spruce, the acreage burned for this purpose is not known.[5]

[5] *Personal communication from Linda R. Donoghue, Research Forester, North Central For. Exp. Stn., East Lansing, Mich.*

French et al. (1968) investigated dwarf mistletoe control by clearcutting infected stands, including a 1- to 2-chain-wide strip into the apparently healthy surrounding stand. They found that elimination of the disease by clearcutting alone was not possible because some small infected trees were missed. Sufficient mistletoe-infected seedlings were present to carry the parasite over to the next generation of black spruce. They concluded that, in addition to clearcutting, the infected area and surrounding buffer zone should be burned. Prescribed burning should eliminate all living spruce more efficiently and economically than clearcutting. Also, the fire may aid in establishment of reproduction because mature trees, even if killed, bear persistent serotinous cones that are capable of disseminating viable seed (Heinselman 1957).

Irving and French (1971) recommend the following broadcast burning conditions to control dwarf mistletoe in black spruce:

1. The fire must have continuous spread and high enough temperature to kill all living black spruce on the treated area.
2. The weather and fuel conditions before, during, and after the fire should permit reasonably safe operations (control of spread and mop-up and patrol).
3. The total cost of eradication should be less than the value of the losses prevented by eliminating dwarf mistletoe.

When the fuel moisture in a black spruce stand is low enough to support continuous fire spread, control can be difficult, dangerous, and expensive. However, by fuel manipulation through clearcutting, it is possible to burn under weather conditions that would not result in uncontrolled wildfires.

The use of fuel oil sprayed on black spruce logging slash to increase spread and intensity of the fire was studied in Minnesota (Irving and French 1971). The resulting fire killed all the black spruce infected with mistletoe. Use of fuel oil is no longer recommended, however, because effective prescribed burns can be achieved without it.[6] The weather conditions which resulted in "cooperative" fire behavior occurred in late afternoon or early evening: (1) windspeed — 0 to 3 miles per hour; (2) air temperature — 60° to 70°F; (3) relative humidity — 29 to 40 percent and rising.

Johnson (1971b, 1973) stated that the establishment and growth of new stands of black spruce are favored by broadcast burning of the slash if any of the following conditions exist: (1) dwarf mistletoe is abundant; (2) brush is abundant; (3) sphagnum seedbeds are poorly distributed; and (4) heavy slash covers the area.

Johnson (1971a) reported that broadcast burning on organic soils in central Minnesota can be effective and economical. Besides preparing the site, the burns should also eradicate dwarf mistletoe. He believes that forest managers in Wisconsin and Michigan can also broadcast burn for mistletoe control after some local experience.

The requirements for setting and conducting a successful broadcast burn are (Johnson 1971b):

1. Make sides of clearcut smooth and straight.
2. Leave a slash-free alley about one-half chain wide between the slash-covered area and surrounding area.
3. Distribute the slash as completely and evenly as possible inside the slash-covered area.
4. Cut all merchantable trees near the edge of the slash-covered area.
5. Burn slash within a year after harvesting.
6. Burn when the fire will consume most slash but not cause a control problem.

Burning was conducted from June to October when at least 0.1 inch of precipitation had fallen at least 3 to 10 days before a burn. Other weather criteria for burning were: (1) 30 to 60 percent relative humidity; (2) 60° to 90°F maximum temperature; and (3) 5 to 15 miles per hour maximum windspeed.

Other Coniferous Species

Prescribed burning of slash in cutover areas is also used to kill mistletoe-infected, residual western hemlocks in the Pacific Northwest (Shea 1966, Russell 1971), Southeastern Alaska (Viereck and Little 1972), and in British Columbia (Smith and Baranyay 1970, Anonymous 1974).

Weir (1916b) suggested using prescribed fire to eliminate infected western larch residuals in harvested areas. Little information is available on prescribed burning for mistletoe control of other western conifers, but some degree of mistletoe reduction is accomplished through traditional prescribed burning practices.

Conclusions

Wildfires have been a primary factor in determining the distribution and intensity of dwarf mistletoes in unmanaged stands. In general, wildfires have tended to keep these widespread parasites in check. With the introduction of fire exclusion policies in most areas of the West in the last half century or so, dwarf mistletoes have increased, both in area affected and intensity. Reduction of dwarf mistletoes by wildfires is generally crude and inefficient, because many healthy trees may be killed as well, depending on the type of burn. Encouraging wildfires in forests managed primarily for wood production in hopes that they will significantly reduce dwarf mistletoe losses cannot now be generally recommended, as these parasites can usually be controlled more effectively by other silvicultural means. However, the possible encouragement of naturally occurring wildfires to reduce dwarf mistletoes in wilderness and park areas should be investigated.

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[6] *Personal communication from D. W. French, Professor of Plant Pathology, Univ. Minn., St. Paul.*

Prescribed fire as a management tool to minimize dwarf mistletoes has been intensively studied and practiced in the Lake States, but to a much lesser extent in the West. Prescribed burning can serve two purposes in relation to mistletoe control: (1) to eliminate infected residual trees in logged-over areas; and (2) to destroy stands that are so heavily infested that the site is unproductive so they can be replaced with young healthy stands.

Research Needs

Very little quantitative information on how wildfires affect the distribution and intensity of dwarf mistletoes is available (Hawksworth 1961a, 1975; Wright and Heinselman 1973). Similarly, few data are available on the possibilities of using fire as a mistletoe control tool, particularly in Western North America.

Fire ecology. — The relationship between fire and dwarf mistletoe distribution should be investigated for each forest and stand type. Some specific problems that should be considered are:

- Can the role of fire in the development of various forest types and their dwarf mistletoes be quantified?
- Have dwarf mistletoes actually increased in the decades since the introduction of fire exclusion policies?
- Can the differences in dwarf mistletoe occurrence in various topographic sites be attributed, at least in part, to fire history?
- What are the direct effects of smoke on dwarf mistletoe shoots, fruits, and seeds?
- What temperatures are lethal to dwarf mistletoe plants?
- How are fuel generation and fire behavior potential elements affected by dwarf mistletoe?

Prescribed burning as a control tool. — The effectiveness of fire in controlling dwarf mistletoe is a function of (1) fire intensity, (2) duration of the burn, (3) rate of spread, (4) fuel arrangement, and (5) heat resistance of the mistletoe plant. Effective mistletoe control depends upon developing and applying the optimum fire prescription for the stand in question. The prescription involves specification of techniques of burning and timing of the treatment (season and weather) to achieve the desired fire intensity. Fuel moisture, by all timelag classes (Deeming et al. 1972) should be considered in developing fire prescription guidelines for prescribed burning operations where mistletoe control is an objective.

Research in the use of prescribed fire for mistletoe control should attempt to answer the following questions, particularly in western North America.

- What fire intensities are needed to effectively control dwarf mistletoes in unmerchantable residual trees in logged areas?
- What are the optimum prescriptions for burning heavily infested unmerchantable stands?
- What is the feasibility of utilizing prescription wildfires in limiting dwarf mistletoe distribution and abundance in wilderness or park areas?

Literature Cited

Anonymous.
1974. Delicate logging slated for diseased forest. B.C. Logging News 1(7):25.

Ainscough, Grant L.
1971. Forest practices and ecology — fire!! p. 7-11. **In** West. For. and Conserv. Assoc., West. For. Pest Conditions, 1970.

Anderson, Ralph L.
1949. The black spruce dwarf mistletoe in Minnesota. M.S. Thesis. 139 p. Univ. Minn., St. Paul.

Anderson, Ralph L., and F. H. Kaufert.
1953. The control of dwarf mistletoe on black spruce. Minn. For. Notes 13, 2 p. Univ. Minn., St. Paul.

Andrews, Stuart R.
1957. Dwarfmistletoe of ponderosa pine in the Southwest. U.S. Dep. Agric., For. Pest Leafl. 19, 4 p.

Andrews, Stuart R., and John P. Daniels.
1960. A survey of dwarfmistletoes in Arizona and New Mexico. U.S. For. Serv., Rocky Mt. For. and Range Exp. Stn., Stn. Pap. 49, 17 p. Fort Collins, Colo.

Baranyay, J. A.
1970. Lodgepole pine dwarf mistletoe in Alberta. Can. Dep. Fish. and For., Can. For. Serv. Publ. 1286, 22 p.

Baranyay, J. A.
1972. Silvicultural control for dwarf mistletoe in young lodgepole pine stands in Alberta and British Columbia. Can. For. Serv., Pac. For. Res. Cent., Int. Rep. BC-29, 38 p. Victoria, B.C.

Baranyay, J. A.
1975. Dwarf mistletoe as a factor in the management of lodgepole pine forests in western Canada. p. 359-376. **In** Manage. Lodgepole Pine

Ecosyst. Symp. [Pullman, Wash., Oct. 1973] Proc., 2 vols. David M. Baumgartner, ed. Wash. State Univ., Pullman.

Baranyay, J. A., and R. B. Smith.
1972. Dwarf mistletoes in British Columbia and recommendations for their control. Can. For. Serv., Pac. For. Res. Cent., Inform. Rep. BC-X-72, 18 p. Victoria, B.C.

Beaufait, William R.
1966. Prescribed fire planning in the Intermountain West. USDA For. Serv. Res. Pap. INT-26, 27 p. Intmt. For. and Range Exp. Stn., Ogden, Utah.

Beaufait, William R.
1971. Fire and smoke in Montana forests. p. 1-23. **In** Forest Land Use and the Environment, R. M. Waddel, ed., Univ. Mont., Missoula.

Beckwith, L. C., and R. L. Anderson.
1956. The forest insect and disease situation, Lake States, 1956. U.S. Dep. Agric., For. Serv., Lake States For. Exp. Stn., Stn. Pap. 42, 25 p. St. Paul, Minn.

Biswell, Harold H., Harry R. Kallander, Roy Komarek, Richard J. Vogl, and Harold Weaver.
1973. Ponderosa fire management. A task force evaluation of controlled burning in ponderosa pine forests of central Arizona. Tall Timbers Res. Stn., Misc. Publ. 3, 49 p. Tallahassee, Fla.

Boyce, John S.
1961. Forest pathology. Ed. 3, 572 p. McGraw Hill, N. Y.

Brown, James K.
1975. Fire cycles and community dynamics in lodgepole pine forests. p. 429-455. **In** Manage. Lodgepole Pine Ecosyst. Symp. [Pullman, Wash., Oct. 1973] Proc., 2 vols. David M. Baumgartner, ed. Wash. State Univ., Pullman.

Cooper, Charles F.
1960. Changes in vegetation, structure, and growth of southwestern pine forests since white settlement. Ecol. Monogr. 30:129-164.

Deeming, John E., James W. Lancaster, Michael A. Fosberg, R. William Furman, and Mark J. Schroeder.
1972. National fire-danger rating system. USDA For. Serv. Res. Pap. RM-84, 165 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. (Rev. 1974, 53 p.)

Donoghue, Linda R., and Von J. Johnson.
1975. Prescribed burning in the North Central States. USDA For. Serv. Res. Pap. NC-111, 8 p. North Cent. For. Exp. Stn., St. Paul, Minn.

Dowding, Eleanor S.
1929. The vegetation of Alberta III. The sandhill areas of central Alberta with particular reference to the ecology of *Arceuthobium americanum*. J. Ecol. 78:82-105.

French, D. W.
1967. Tree diseases affect Minnesota's forest industry. Minn. Sci. 23(3), [2 p.].

French, D. W., M. P. Meyer, and R. L. Anderson.
1968. Control of dwarf mistletoe in black spruce. J. For. 66:359-360.

Frykman, Joel L.
1972. The Bitterroot dialogue continues. Am. For. 78(3):28-30, 59-62.

Gill, Lake S., and Frank G. Hawksworth.
1961. The mistletoes — a literature review. U.S. Dep. Agric. Tech. Bull. 1242, 87 p.

Gill, Lake S., and Frank G. Hawksworth.
1964. Dwarfmistletoe of lodgepole pine. U.S. Dep. Agric., For. Pest Leafl. 18 (Rev.), 7 p.

Graham, Donald P.
1960. Surveys expose dwarf mistletoes. Problem in Inland Empire. West. Conserv. J. 17(1): 56-58.

Graham, Donald P.
1961. Dwarfmistletoe of Douglas-fir. U.S. Dep. Agric., For. Pest Leafl. 54, 4 p.

Hawksworth, Frank G.
1958a. Rate of spread and intensification of dwarfmistletoe in young lodgepole pine stands. J. For. 56:404-407.

Hawksworth, Frank G.
1958b. Survey of lodgepole pine dwarfmistletoe on the Roosevelt, Medicine Bow, and Bighorn National Forests. U.S. Dep. Agric., For. Serv., Rocky Mt. For. and Range Exp. Stn., Stn. Pap. 35, 13 p. Fort Collins, Colo.

Hawksworth, Frank G.
1959. Distribution of dwarf mistletoes in relation to topography on the Mescalero-Apache Indian Reservation, New Mexico. J. For. 57:919-922.

Hawksworth, Frank G.
1961a. Dwarfmistletoe of ponderosa pine. Recent Adv. Bot. 2:1537-1541.

Hawksworth, Frank G.
1961b. Dwarfmistletoe of ponderosa pine in the Southwest. U.S. Dep. Agric. Tech. Bull. 1246, 112 p.

Hawksworth, Frank G.
1968. Mistletoes of the Southwest and Mexico. **In** Proc. 15th West. Int. For. Dis. Work Conf. 1967: 18-21.

Hawksworth, Frank G.
1969. Ecological aspects of dwarf mistletoe distribution. **In** Proc. 16th West. Int. For. Dis. Work Conf. 1968:74-82.

Hawksworth, Frank G.
1975. Dwarf mistletoe and its role in lodgepole pine ecosystems. p. 342-358. **In** Manage. Lodgepole Pine Ecosyst. Symp. [Pullman, Wash., Oct. 1973] Proc., 2 vols. David M. Baumgartner, ed. Wash. State Univ., Pullman.

Hawksworth, Frank G., and Thomas E. Hinds.
1964. Effects of dwarfmistletoe on immature

lodgepole pine stands in Colorado. J. For. 62:27-32.

Hawksworth, Frank G., and Arthur A. Lusher.
1956. Dwarfmistletoe survey and control on the Mescalero-Apache Reservation, New Mexico. J. For. 54:384-390.

Hawksworth, Frank G., and Delbert Wiens.
1972. Biology and classification of dwarf mistletoes *(Arceuthobium)*. U.S. Dep. Agric., Agric. Handb. 401, 234 p.

Heinselman, M. L.
1957. Silvical characteristics of black spruce *(Picea mariana)*. U.S. Dep. Agric., For. Serv., Lake States For. Exp. Stn., Stn. Pap. 45, 30 p. St. Paul, Minn.

Heinselman, M. L.
1970. The natural role of fire in northern coniferous forests. p. 30-41. **In** Symp. on the Role of Fire in the Intermountain West. Intermt. Fire Res. Counc., Missoula, Mont.

Heinselman, M. L.
1973. Fire in the virgin forests of the Boundary Waters Canoe Area, Minnesota. Quat. Res. 3: 329-382.

Howe, George E.
1973. The forest genetics program for the Northern Region. U.S. Dep. Agric., For. Serv., North. Reg. 78 p. Missoula, Mont.

Irving, F. D., and D. W. French.
1971. Control by fire of dwarf mistletoe in black spruce. J. For. 69:28-30.

Isaac, Leo A.
1963. Fire — a tool not a blanket rule in Douglas-fir ecology. Tall Timbers Fire Ecol. Conf. 2:1-17. Tallahassee, Fla.

Johnson, William F.
1971a. Broadcast burning slash favors black spruce reproduction on organic soil in Minnesota. For. Chron. 47:33-35.

Johnson, William F.
1971b. Management guide for the black spruce type in the Lake States. USDA For. Serv. Res. Pap. NC-64, 12 p. North Cent. For. Exp. Stn., St. Paul, Minn.

Johnson, William F.
1973. Black spruce. p. 62-63. **In** Silvicultural systems of the major forest types of the United States. U.S. Dep. Agric., Agric. Handb. 445, 124 p.

Johnson, William F.
1975. Reproducing lowland conifer forests. J. For. 73:17-20.

Jones, John R.
1974. Silviculture of southwestern mixed conifers and aspen: The status of our knowledge. USDA For. Serv. Res. Pap. RM-122, 44 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Kiil, A. D.
1969. Basic considerations in the planning and use of prescribed fire. For. Res. Lab., Inform. Rep. A-X-21, 11 p. Edmonton, Alberta.

Kimmey, J. W.
1957. Dwarfmistletoes in California and their control. U.S. Dep. Agric., For. Serv., Calif. For. and Range Exp. Stn., Tech. Pap. 19, 12 p. Berkeley, Calif.

Kimmey, J. W. and Donald P. Graham.
1960. Dwarfmistletoes of the Intermountain and Northern Rocky Mountain Regions and suggestions for control. U.S. Dep. Agric., For. Serv., Intermt. For. and Range Exp. Stn. Res. Pap. 60, 19 p. Ogden, Utah.

Kimmey, J. W., and James L. Mielke.
1959. Western dwarfmistletoe on ponderosa pine. U.S. Dep. Agric., For. Pest Leafl. 40, 7 p.

Komarek, E. V.
1963. Fire, research and education. Tall Timbers Fire Ecol. Conf. 2:181-187. Tallahassee, Fla.

Kuijt, Job.
1955. Dwarf mistletoes. Bot. Rev. 21:569-627.

LeBarron, Russell K.
1947. Discussion of lodgepole pine cutting methods. North. Rocky Mt. For. and Range Exp. Stn., Mimeo Rep. May 21, 14 p. Missoula, Mont.

LeBarron, Russell K.
1948. Silvicultural management of black spruce in Minnesota. U.S. Dep. Agric., Circ. 791, 60 p.

LeBarron, Russell K.
1952. Silvicultural practices for lodgepole pine in Montana. U.S. Dep. Agric., For. Serv., North. Rocky Mt. For. and Range Exp. Stn., Stn. Pap. 33, 19 p. Missoula, Mont.

Loope, Lloyd L.
1971. Dynamics of forest communities in Grand Teton National Park. Naturalist 22(1):39-47.

Lotan, James E.
1975. The role of cone serotiny in lodgepole pine forests. p. 471-495. **In** Manage. Lodgepole Pine Ecosyst. Symp. [Pullman, Wash., Oct. 1973] Proc., 2 vols. Wash. State Univ., Pullman.

Lyon, L. Jack.
1971. Vegetal development following prescribed burning of Douglas-fir in south central Idaho. USDA For. Serv. Res. Pap. INT-105, 30 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Lyon, L. Jack, and W. Leslie Pengelly.
1970. Commentary on the natural role of fire. p. 81-84. **In** Symp. on the Role of Fire in the Intermountain West. Intermt. Fire Res. Counc., Missoula, Mont.

Muir, John A.
1970. Dwarf mistletoe spread in young lodgepole pine stands in relation to density of infection sources. Can. Dep. Fish. and For. Bi-Monthly Res. Notes 26:49.

Parmeter, J. R., Jr., and Robert F. Scharpf.
1963. Dwarfmistletoe on red fir and white fir in California. J. For. 61:371-374.

Parmeter, J. R., Jr., and B. Uhrenholdt.
1975. Some effects of pine-needle or grass smoke on fungi. Phytopathology 65:28-31.

Pechanec, Joseph F.
1970. Research needed to guide fire management direction. p. 153-161. **In** Symp. on the Role of Fire in the Intermountain West. Intermt. Fire Res. Counc., Missoula, Mont.

Roth, Lewis F.
1953. Pine dwarfmistletoe on the Pringle Falls Experimental Forest. U.S. Dep. Agric., For. Serv., Pac. Northwest For. and Range Exp. Stn., Res. Note 91, 3 p. Portland, Oreg.

Roth, Lewis F.
1954. Distribution, spread and intensity of dwarf mistletoe on ponderosa pine. Phytopathology 44:504 (Abstr.).

Roth, Lewis F.
1966. Foliar habit of ponderosa pine as a heritable basis for resistance to dwarf mistletoe. p. 221-228. **In** Breeding pest-resistant trees, H. D. Gerhold et al., eds., Pergamon Press, New York.

Roth, Lewis F.
1974a. Juvenile susceptibility of ponderosa pine to dwarf mistletoe. Phytopathology 64:689-692.

Roth, Lewis F.
1974b. Resistance of ponderosa pine to dwarf mistletoe. Silvae Genetica 23:116-120.

Russell, Kenelm W.
1971. Precommercial thinning in dwarfmistletoe control. p. 23-40. **In** Proc. Symp. on Precommercial Thinning of Coastal and Intermountain Forests of the Pacific Northwest, D. M. Baumgartner, ed., Washington State Univ., Pullman.

Sando, R. W., and R. C. Dobbs.
1970. Planning for prescribed burning in Manitoba and Saskatchewan. Can. Dep. Fish. and For. Liaison and Services Note MS-L-9, 18 p.

Shea, Keith R.
1966. Dwarfmistletoe of coastal western hemlock: principles and practices for control. Weyerhaeuser For. Pap. 9, 14 p.

Shea, Keith R., and Benton Howard.
1969. Dwarf mistletoe control: a program for research and development in the West. p. 25-32. **In** West. For. and Conserv. Assoc., West. For. Pest Conditions, 1968.

Shea, Keith R., and James L. Stewart.
1972. Hemlock dwarf mistletoe. U.S. Dep. Agric., For. Pest Leafl. 135, 6 p.

Smith, Richard B.
1966. Hemlock and larch dwarf mistletoe seed dispersal. For. Chron. 42:395-401.

Smith, R. B.
1971. Cutting practices — silvicultural control of dwarf mistletoes. p. 34-36. **In** West. For. and Conserv. Assoc., West. For. Pest Conditions, 1970.

Smith, R. B., and J. A. Baranyay.
1970. Dwarf mistletoes in British Columbia. Can. For. Serv., For. Res. Lab., Misc. Publ. BC-M3-71, 8 p. Victoria, B.C.

Taylor, Dale L.
1969. Biotic succession of lodgepole pine forests of fire origin in Yellowstone National Park. Ph.D. Thesis, 320 p. Univ. Wyo., Laramie.

Tinnin, R. O., and D. M. Knutson.
1973. Douglas-fir dwarf mistletoe is west of the Cascade Divide. Plant Dis. Rep. 57:716-718.

U.S. Department of Agriculture, Forest Service.
1973. Fremont National Forest conducts dwarfmistletoe control project with prescribed fire. R-6 Fuels Manage. Notes 1(8), 4 p. Div. Fire Manage., Pac. Northwest Reg., Portland, Oreg.

Viereck, Leslie A., and Elbert L. Little, Jr.
1972. Alaska trees and shrubs. U.S. Dep. Agric., Agric. Handb. 410, 265 p.

Weaver, Harold.
1967a. Fire and its relationship to ponderosa pine. Tall Timbers Fire Ecol. Conf. 7:127-149.

Weaver, Harold.
1967b. Fire as a continuing ecological factor in perpetuation of ponderosa pine forest in western United States. Adv. Front. Plant Sci. 18:137-154.

Weaver, Harold.
1974. Effects of fire on temperate forests: Western United States. p. 279-319. **In** Fire and Ecosystems, T. T. Kozlowski and C. E. Ahlgren, eds. Acad. Press, N. Y.

Webb, Ralph C.
1971. A guide to the plants of the Pinnacles. 76 p. Southwest Parks and Monuments Assoc., Globe, Ariz.

Weir, James R.
1916a. Larch mistletoe: Some economic considerations of its injurious effects. U.S. Dep. Agric., Bull. 317, 25 p.

Weir, James R.
1916b. Mistletoe injury to conifers in the Northwest. U.S. Dep. Agric., Bull. 360, 38 p.

Weir, James R.
1916c. Some suggestions on the control of mistletoe in the forests of the Northwest. For. Quart. 14:567-577.

Wellwood, R. W.
1956. Some effects of dwarf mistletoe on western hemlock. For. Chron. 32:282-296.

Wright, H. E., Jr., and M. L. Heinselman.
1973. The ecological role of fire in natural conifer forests of western and northern North America — introduction. Quat. Res. 3:319-328.

Agriculture—CSU, Ft. Collins

Alexander, Martin E., and Frank G. Hawksworth.
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Wildfires play a multiple role in the distribution of dwarf mistletoes — they may either inhibit or encourage these parasites depending primarily on the size and intensity of the burn. Many reports suggest that fire exclusion policies of the past half century have resulted in increased dwarf mistletoe levels as well as increased fire behavior potential. Prescribed burning as a supplemental method of dwarf mistletoe control has been little used, but seems to be applicable in some forest types and stand conditions both to eliminate infected residuals in cutover areas and to eliminate heavily infested unmerchantable stands. Suggested areas of research relating to fire ecology and prescribed burning are given.

Keywords: *Arceuthobium,* wildfires, prescribed burning, fire ecology.

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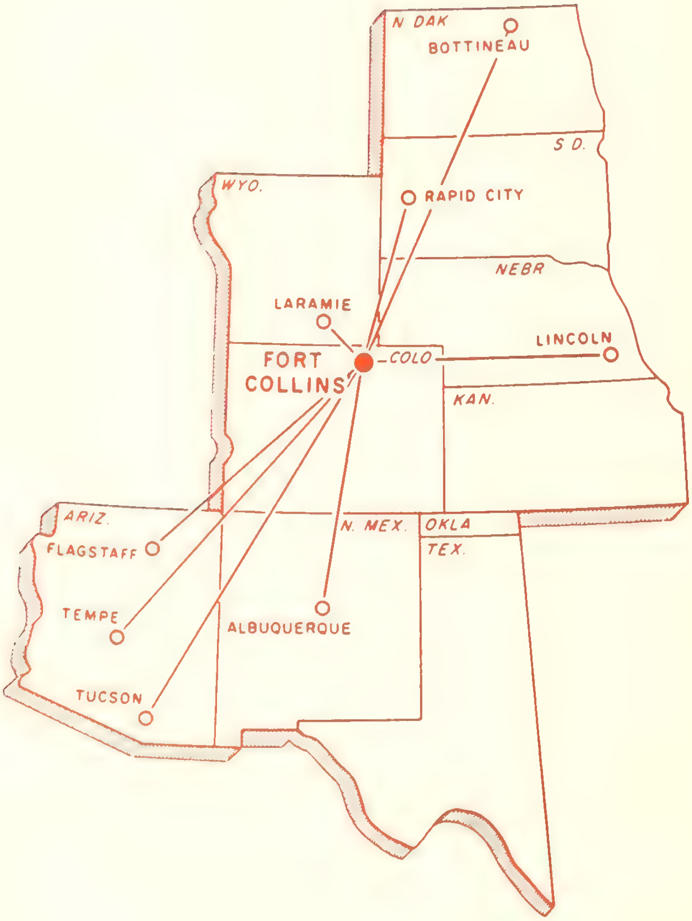
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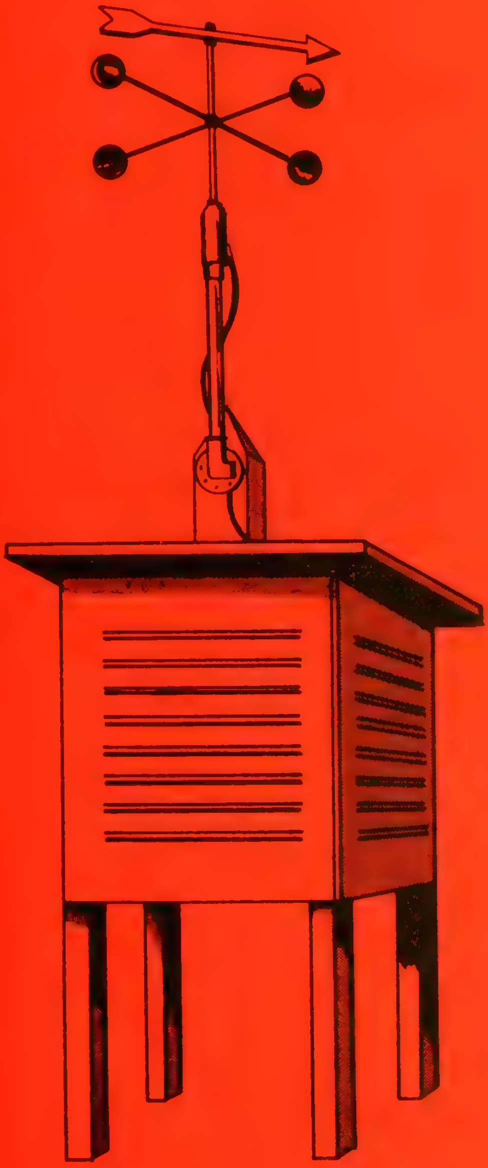
User's Guide to

AFFIRMS:

Time-Share Computerized Processing for Fire Danger Rating



USDA Forest Service
General Technical Report RM-15

August 1975

Rocky Mountain Forest and
Range Experiment Station
Forest Service
U.S. Department of Agriculture
Fort Collins, Colorado 80521

ABSTRACT

Helfman, Robert S., John E. Deeming, Robert J. Straub, and R. William Furman.
1975. User's guide to AFFIRMS: Time-share computerized processing for fire danger rating. USDA Forest Service General Technical Report RM-15, n.p. [107 p.]. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. 80521

Procedures for processing fire danger data utilizing a time-share computer via a remote terminal are presented in non-technical language for persons without computer background. Input includes fuels and weather information; output includes narrative messages sent from other users, displays of observed and forecasted weather, and fire danger indexes. Observed fuels and weather input data are automatically checked for errors and archived. Examples are given.

Key words: Computer, Fire Danger Rating, Fire Weather

SDA Forest Service
General Technical Report RM-15

AUGUST 1975

User's Guide to AFFIRMS:

Time-Share Computerized Processing for Fire Danger Rating

Administrative and
Forest
Fire
Information
Retrieval and
Management
System

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Rocky Mountain Forest and Range Experiment Station[1]

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[1] Central headquarters maintained at Fort Collins, in cooperation with Colorado State University. Helfman is with the Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif. Deeming, now with the Northern Forest Fire Laboratory, Intermountain Forest and Range Experiment Station, Missoula, Mont., and Straub were with the Rocky Mountain Station's National Fire Danger Rating Research Work Unit, Boise Interagency Fire Center, Idaho. Furman is in Fort Collins.

AFFIRMS Reference List

Command	Purpose	Section
ARCH	Enter non-current weather for archiving	2.2.2
BYE	End a session with AFFIRMS	1.4.3
CTLG	Specify initial catalog entry for a station	2.1.1
DATE	Temporarily modify the date to affect data entry	1.4.6
DEL	Remove a station from the catalog	2.1.8
DESC	List the station catalog	2.1.7
DSPI	Display weather and fuels information, and fire danger ratings	1.5.1
DSPU	Display weighted fire danger rating	1.5.3
DSPW	Display weather information	1.5.1
DSPX	Display fire danger ratings	1.5.1
FCST	Enter forecasted weather for a specific station	3.1.1
FILE	Create, delete, list, or execute user-defined files	1.7
FWXZ	Change a station fire weather zone	2.1.10
HDEF	Define type of moisture data to be entered for a station	2.1.2
HELP	Get tutorial information about AFFIRMS commands	1.2.5
HERB	Specify the herbaceous veg. condition	2.1.5
LINK	Access ancillary routines	4.3
MODL	Specify the fuel models for a station	2.1.4
NAME	Change a station name	2.1.9
OBS	Enter regularly scheduled weather observations	2.2
OPT	Specify NFDRS index to be used for "manning class" and weather data permitted to be entered as missing	2.1.3
POST	Cause automatic routing of messages to other users	1.8.1
SET	Control various program operations	1.4.7-.11 & 4.1.1-3
SIG	Originate, modify, list, or eliminate a special interest group	1.6
SPC	Enter off-station or off-hour weather observations	2.2.2
STOW	Apply a FCST or ZONE command to a temporary grouping of stations or forecast zones	3.1.4
WOOD	Specify the woody veg. condition	2.1.6
ZONE	Enter forecasted weather trends for a fire-weather-zone	3.1.2
*	Producing headings on your output	1.7.3

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1.1

One of the most powerful features of AFFIRMS is its automatic archiving program. Normally AFFIRMS retains only one regular observation per station. Entry of a new observation replaces the old one. An independent computer program, called the ARCHIVER, operates automatically every night at 2300 hours Mountain Standard Time. ARCHIVER inspects the files into which AFFIRMS places its regular observations. Any such observations which are recognized as current will be copied and added to an archive file.

ARCHIVER retains the fire danger observation records throughout the month. On the last night of the month it causes all the records for that month to be dumped out onto cards or tape and shipped to the National Fire Danger Rating project headquarters for subsequent distribution. All of this data handling is entirely automatic. The manual keypunching of fire weather data is eliminated.

The logic of AFFIRMS permits most commands to be used in any order, any number of times. Each command is processed as it is entered, and once processed, frees AFFIRMS for new tasks. AFFIRMS is intended to be user-proof; that is, most operator errors have been anticipated and can be detected and noted without disrupting the system in any way.

To avoid the necessity of repeatedly entering station-dependent semipermanent parameters, such as station elevation, agency, time zone, etc., a station catalog is used to store this information for program retrieval as needed. Commands are available for cataloging and uncataloging stations, as well as for specifying fuel models, slope classes, fuel conditions, and data availability.

Weather data can be entered as regular-schedule observations, off-hour or off-station special observations, and forecasts. In addition, a zone forecast feature permits entry of weather trends for an entire fire-weather forecast zone. The trends are then automatically applied to all stations in the zone and forecasts are generated for each station, based on the current weather.

Display commands are provided which permit a large selection of display options of weather or NFDR indices. Users may define special interest groups (S.I.G.) to permit groupings of stations outside the usual aggregations of county, state, region, etc.

File-manipulation commands allow users to create, purge, list, and execute text files. Such files are automatically made accessible to all other users, facilitating transmission of plain-language information from user to user. A posting command is included to permit automatic routing of messages to other users. Several control commands are provided to permit steering of program operations.

1.1.1 Organization of the User's Guide

We anticipate the need to revise the User's Guide from time to time. The book is designed to allow updating instructions by issuing one or more pages rather than reprinting the entire book. Note that instead of page numbers we have used chapter and sub-chapter headings for easy insertion and deletion of material. We suggest filing the Guide in a loose-leaf binder.

Chapter 1 contains instructions for all users; Chapter 2 is for the Fire Manager; Chapter 3 is for Fire Weather Forecasters, and Chapter 4 is for Regional Fire Managers. The Appendix contains more specific information.

1.2 ** PROGRAM COMMANDS **

Commands are entered into the keyboard of your data terminal whenever your terminal prints:

```
COMMAND?
```

This is a prompter to indicate that the program is awaiting your next request. If any other response occurs after an operation, see Appendix I for guidance.

After typing a command, hit the carriage-return key. This signals the computer that you are ready to have your command processed.

1.2.1 Command Format

All commands have a simple basic format, as described below:

1) All begin with a verb--a 3 or 4-letter abbreviation for the kind of operation you wish to perform. No spaces are allowed between the prompter and the verb.

2) Following the verb is a list of one or more operands--the numeric or alphabetic items which are the input to the command. The verb and operands must be separated from each other by your choice of _either_ a space, a comma, or a slash.

3) The number of operands varies, depending on the command used. Most commands require one or more operands; some require none at all. Some commands have a variable number of operands.

Here are some examples:

```
COMMAND?CTLG 292001 1720 MST GILA 3 1 15 8
COMMAND?DATE 72/04/15
COMMAND?DSPW OBS,REG,3
COMMAND?DSPI/FCST,FOR/GILA 3
COMMAND?DEL 020209
COMMAND?POST,501,009,527,634,011,465
COMMAND?BYE
```

You will discover the purpose of each of these commands later in the User's Guide.

***-Note: In the first command, a space was used as a separator, in the second a slash, in the third a comma, and in the fourth we intermixed all three. In the fifth command there is only one operand, while the last command has none.

1.2.2 Continuing Commands on a Second Line

Some commands, particularly OBS, SPC, and FCST can be quite long. You may continue any command onto a second line by ending the first line with an ampersand (&) followed by a carriage return. AFFIRMS will then ask OK MORE?, and you can continue typing the command. Note that AFFIRMS simply attaches the text of the second line to the first line, leaving out the ampersand. If a separator (space, comma, slash) was needed, it must either precede the ampersand on the first line, or be the first character typed on the second line. An example of continuation:

```
COMMAND?OBS 292001,13,1,85,78,1,15,NW,5,3,90,&
OK MORE?72,90,30,0,0,1,23
```

1.2.3 Entering Missing Data

In certain situations, if permitted, you may wish to indicate missing data for one or more operands. This may be accomplished by using the single letter M as an operand.

Only the OBS, SPC, FCST, ZONE, DSPU and ARCH commands permit missing-data entries, and only in certain operands. In an OBS command, you would indicate a missing maximum temperature this way:

```
                                        ↓
COMMAND?OBS 292001,15,1,69,65,1,30,NE,3,10,M,56,85,34,0,0,1,24
```

1.2.4 Requesting AFFIRMS Operational Schedule -- NETSCHED

Periodically the hours that AFFIRMS is available change as G.E. schedules regular maintenance or changes hardware. These changes are announced by G.E. with a message like:

```
HH
U#=LAN68709,GEORGE,STRAUB

PLEASE RUN SCHED*** FOR WEEKEND SCHEDULE CHANGES.

NFDR AFFIRMS (RSH:118/25/ 4/ 5)

FOR AID, ENTER: HELP
OR CALL (208) FTS 588-9287 COM 336-2200 EXT. 287
```

The normal AFFIRMS user doesn't have the capability to run SCHED***. Therefore, the AFFIRMS staff does this for you and places the changes in a permanent file named NETSCHED. To receive a copy of the schedule, follow the illustration below.

```
COMMAND?FILE LIST NETSCHED


AFFIRMS NETWORK SERVICE AVAILABLE 24 HOURS EXCEPT:

OFF SAT. 14:45 TO 15:00 MDT

OFF SAT. 22:00 TO SUN. 08:00 MDT

OFF MON. 21:45 TO MON. 22:00 MDT

OFF TUE. 04:45 TO TUE. 05:00 MDT
```

***Note: This is an illustration only and may be very different from the actual schedule on any given date.

1.2.5 Getting Tutorial Assistance--The HELP Command

The HELP command provides tutorial information about AFFIRMS commands. No operands are used. For example:

```
COMMAND?HELP
```

AFFIRMS will respond by printing a summary of command forms on your data terminal. When the command in question has been listed, you can prevent the complete listing of these tutorials by hitting the Break-Key.

1.2.6 Requesting Past NFDR-AFFIRMS Announcements -- BLURBS

Both the National Fire Danger Rating System and AFFIRMS are dynamic systems with both technical and administrative changes occurring from time to time. If you are a new user, or an old one returning after an absence of several months, check the file named BLURBS to bring yourself up to date. An example of this request:

```
COMMAND?FILE LIST BLURBS


ALL USERS:

PLEASE REMEMBER THAT IF YOU EVER GET AFFIRMS ERROR MESSAGES WHICH
HAVE THE LETTER 'R' AS THE 7TH CHARACTER OF THE MESSAGE NUMBER, YOU
SHOULD CONTACT BOISE OR RIVERSIDE A.S.A.P.

FOR EXAMPLE...
      .........THIS IS THE LETTER TO WATCH FOR:
          :
   FIL03R SEQ. FILE READ-ERROR, CODE:      107
THE 'R' STANDS FOR 'REFERRAL'.  THE USUAL SUFFIX IS 'A' FOR ACTION
OR 'I' FOR INFORMATION.


ALL AFFIRMS USERS:

G.E. WILL BE MOVING US FROM SYSTEM 'B' TO SYSTEM 'L' LATE THIS
SATURDAY (NOV. 2) EVENING.

ALL THIS MEANS IS THAT YOUR USER NUMBER'S FIRST LETTER WILL CHANGE
FROM 'B' TO 'L'.  EXAMPLE: BAN68711 BECOMES LAN68722.

PLEASE REPORT ANY STRANGE GOINGS-ON AFTER THE CHANGE-OVER HAS BEEN
MADE.


COMMAND?
```

***-Note: In this example BLURBS contained only two announcements. You were returned to the COMMAND point when the list was complete. Since the list is typically much longer, read along with the printer and terminate the listing by hitting the Break-Key when you begin to see familiar announcements.

1.2.7 Directory of AFFIRMS Users -- USERLIST

A directory of user numbers, names, and three or four letter abbreviations is available from an AFFIRMS file. User numbers are used for the POST command explained in Section 1.8.1. Four letter abbreviations are used in the DSP commands specifying a particular Forest or unit as explained in Section 1.5.1. Three letter airport codes of National Weather Service offices are used to obtain fire weather forecast narratives as explained in Sections 2.3 and 3.1.6. To receive this list, type:

```
COMMAND?FILE LIST USERLIST
```

This list of users is several pages long and changes infrequently. Requesting it once or twice a season should be sufficient. Some Regional Offices have saved money by sending machine copies of their user list to users in their zone of influence.

1.3 ** TROUBLE SHOOTING **

1.3.1 Error Detection

AFFIRMS can detect many common errors, including 1) bad syntax, 2) impossible or inconsistent data-values, and 3) required data entered as missing. In most cases, the specific location of the error in the command-line will be indicated with an up-arrow (↑). For example:

```
COMMAND?MODL 292001,5,A,1,0810,B,3,071235
ERROR AT                           ↑
CTL04A IMPROPER LENGTH
COMMAND?
```

The program indicates where the error was detected and a brief note is made of the kind of error found. The error code, CTL04A, may be looked up in Appendix I of this guide, where a more detailed explanation is provided. In this case, AFFIRMS detected that the manning index percentiles for a MODL command had the wrong number of digits (4 were expected, 6 were found.)

1.3.2 Error Correction

The AFFIRMS program allows two methods of correcting errors in a line of input before the carriage return key is depressed. The operator can delete individual characters in a line or the entire line if needed. Different brands of computer terminals have different symbols for these functions. The back arrow is the most common back space symbol and the "control X" the most common way of deleting a complete line. Instruction manuals, sales representatives, or the office listed at the front of this publication can help you with specific questions. Examples of these functions follow:

```
COMMAND?DSPQ←I OBS LIST 041010 040101

COMMAND?QSPI OBS LIST 041010 040101 DELETED
DSPI OBS LIST 041010 040101
```

In the first example, the back arrow caused the computer to back up one space allowing the letter I to be typed in to replace the erroneous letter Q. In the second example, the error was not recognized until the entire line was completed. It is not practical to use multiple back spaces to clear the entire line. A "Break" key or carriage return would cost about 15¢ because AFFIRMS would respond with an error message. The line was deleted by pressing the control key and the "X" at the same time. "DELETED" is printed and the carriage returns to the left hand margin. Since the computer did not see the deleted material, a COMMAND? prompter was not printed. The corrected input line was typed starting at that point. See Section 1.4.4 for use of the "Break" key.

1.3.3 System Failures

Because AFFIRMS is a computer program which operates on a national time-sharing computer network, it is possible for certain types of system failures to directly affect the AFFIRMS user. Under some conditions you may receive error messages which do not originate in AFFIRMS, but rather in the computer operating system itself. The more common conditions are discussed in Appendix I; examples might be:

1. SERVICE TEMPORARILY INTERRUPTED
2. THAT SYSTEM IS UNAVAILABLE AT PRESENT
3. Phone rings--but no answer
4. ::SOME MESSAGE::

```
LINE CALLING-ROUTINE
999   ::SOMENAME::
999   ::SOMENAME::
  ......ETC......
```

***-Note-In the situations listed above, the user would contact G.E. himself for the first three problems. The fourth should be referred to the AFFIRMS staff at the telephone numbers listed on the title page. The toll-free G.E. trouble number is 800-638-2960.

1.4 ** STEERING PROGRAM OPERATIONS **

1.4.1 Accessing AFFIRMS

The AFFIRMS program can be reached by a large number of computer terminals, all of similar construction but with varying keyboard layouts and hardware switches. Rather than producing instructions for all these possibilities, a few common, but important, switches are discussed. Note that not even these three necessarily exist on your machine. Hardware questions not addressed here can be referred to the staff at the address on the front piece of this manual.

Switch	Position
Duplex	HALF
Mode	ON LINE
Speed	30 (however, 15 and 10 will work)
Parity	EVEN

***-Note: Given a choice, always select 30 characters per second as your sending speed since faster printing reduces the time spent on the system and, therefore, reduces costs.

An AFFIRMS session normally begins by dialing the local telephone number of the computer network on which AFFIRMS is implemented. When the computer "answers" and sends back a high-pitched tone, the handset of your telephone is placed into the audio-coupler on your terminal. The audio-coupler has two rubber cups which exactly fit a standard phone handset. As soon as your terminal detects the presence of the carrier signal, it will send back an acknowledging signal and will light up an indicator on its control panel. Usually this light is marked as Carrier Detect, Ready-to-Send, or On-Line. No light at this point usually indicates that the telephone handset is in backwards.

Within the first five seconds after the indicator lights, you must send the character H several times. The computer's port--the device which connects the telephone line to the computer--will analyze the way in which your terminal sent the H and adjust itself to the proper speed and mode of transmission. If no response is made by the computer to your H's, check to insure that your terminal is in the "On-Line" mode.

The computer network will then request that you type in a log-on sequence containing a user-number, password, and user-name. The protocol for this sign-on is very specific and must be followed exactly since you are not yet dealing with AFFIRMS but the operating system. AFFIRMS can usually tell you what mistakes you have made, but since the computer network does not want anyone to use its services who isn't authorized to do so, it is very intolerant of errors during the log-on procedure.

1.4.1
1.4.1.1

You type in the log-on sequence and follow it with carriage return. This key signals the computer to accept your line of information. The computer will never see what you have typed until the carriage return key is hit.

Your user-number will always be specially set up in the computer system so that it has only one possible function--it can access the AFFIRMS program--nothing else! As soon as the user-number is recognized, the AFFIRMS program will be loaded and made ready for your instructions. An example follows:

```
  1/
HH

 2/                     3/     4/
U#=LAN 68707,MARANA,DCP   (CR)

                     5/                          6/     7/
INCORRECT FORMAT, REENTER U#LAN68707,MARANA,DCP   (CR)
```

1/ User typed in HH
2/ Computer has replied U#= indicating "User number equals".
3/ User has entered an incorrect user number, note the space between LAN and 68707.
4/ The carriage return key was depressed signalling the machine the entry is completed.
5/ Computer has rejected the user number and asked for a corrected number. You have three tries to enter a correct user number.
6/ User has correctly entered his user number, password, and user name. Typine started immediately following the last symbol from the computer.
7/ Carriage return key must be depressed at the end of each line of information to enter the information into the computer.

1.4.1.1 Messages Received at the Start of an AFFIRMS Session

After the computer has accepted your user number you will receive several messages. These messages may be from either the computer network or the AFFIRMS program.

Messages from the computer network should be ignored if they direct action on your part. The AFFIRMS staff will carry out any required tasks for all users. An example of a message that should be ignored is:

```
BACKGROUND USERS PLEASE RUN SCHED***FOR UPDATED SCHEDULE CHANGES.
```

Now AFFIRMS will print a message containing the version of the program and the communications equipment identifiers; e.g., NFDR AFFIRMS (RSH:118/25/ 4/ 5)
This line indicates you are using the AFFIRMS program. The information within the parenthesis contains the program version/port number/the remote concentrator/local

concentrator. These last three numbers will be required by G.E. to track down any communications problems that you report.

At this point, you may receive two kinds of messages: 1) messages from the AFFIRMS program staff, 2) messages originating from other users and sent to you by their use of the POST command. An example of these messages follows:

```
FOR AID, ENTER: HELP

OR CALL (208) FTS 588-9287 COM 336-2200 EXT. 287

EXC061 MSG  /DEEM711 / FROM USER-NO. 711 DATED 750609:

DEEMING:  TRIED TO REACH YOUR OFFICE THIS PM BUT COUNDN'T GET THROUGH
YOU CAN REACH ME AT THE 5 R.O. (JACK CARTER'S OFFICE) BETWEEN
10 AM AND 3 PM ON THE 10 TH (TUESDAY).......HELFMAN

---
```

***Note that three dashes (---) signal the end of each message.

Finally, AFFIRMS issues a COMMAND? prompter to tell you it's ready for your first command. An example of the complete sign-on prodecure follows:

```
HH

U#=LAN68707,MARANA,STR


NFDR AFFIRMS (RSH:335/25/ 4/ 5)
FOR AID, ENTER:  HELP ..OR CALL (208) FTS 5889287 COM 3453564

EXC061 MSG 'EXAMP709' FROM USER-NO. 709 DATED 741206:

HI THERE, I SEE THAT YOU HAVE SUCCESSFULLY MADE YOUR FIRST CONTACT
WITH THE AFFIRMS PROGRAM....BOB STRAUB

---

COMMAND?
```

1.4.2 Obtaining a User Number and Password

Contact the National Fire Danger Research Work Unit at the address or telephone numbers shown on the front piece of the User's Guide.

1.4.3 Terminating an AFFIRMS Session--the BYE Command

The BYE command is used to exit from the G. E. System and disconnect your terminal. Sessions should always be ended with BYE as this assures that all system housekeeping has been properly completed. Ending the session by simply hanging up the telephone should be avoided whenever possible.

The command can take two forms. The comments after the examples below indicate what each form does:

BYE;	The session ends and the terminal shuts down.
BYE NEW;	Ends the present session and permits the user to sign on with another user number, password, and ID (combination) without redialing the telephone.

Before the computer disconnects, an estimate of the cost of the session will be printed (this figure <u>does not</u> reflect government discounts).

Terminating an AFFIRMS session:

```
COMMAND?BYE


SESSION COST:  $   2.43
0002.96  CPU      0000.09   TCH     0003.51   KC

OFF AT 08:12MST 10/30/74
```

***-Note: CRU - Computer Resource Units - physical equipment used
TCH - Connect time in decimals of an hour
KC - Thousands of characters sent and received.

On Mondays, AFFIRMS will automatically produce a list of the names of the files saved under that particular user number. This will prevent your creating a text file and then forgetting it. Each file costs about $1.10 per month for the first 1,000 characters saved, and $1.10 for every additional 1,000 saved. An example follows:

```
COMMAND?BYE

SESSION  COST:  $   0.54
EXC31I REMINDER: YOUR CURRENTLY-SAVED TEXT-FILES ARE:

SAVED FILE,     USER NUMBER AN68700
12/23/74              TIME10:11MST
ZERO709 1 OCT       SAVE709     5 NOV     MICH709      11 NOV

0001.15 CRU    0000.02    TCH     0000.72   KC

OFF AT 10:12MST 12/23/74
```

***-Note: On Monday you automatically receive a list of your existing files and the dates that they were last used. If any are obsolete, see 1.7.5 for instructions on purging them.

1.4.4 Escape Provisions (Use of the Break-Key)

If you start to type a command and then wish to abort it and begin again, hit the Break-Key once. You will then be returned to the COMMAND? point.

The Break-Key may be hit at any time to interrupt the program in any task. It is important to realize that the task is actually abandoned. If you enter an OBS command and then hit "Break" before AFFIRMS asks for the next command, the observation will not be stored and cannot be retrieved. See Sec. 1.3.2 for use of the back space and delete functions.

Whenever the Break-Key is hit:

1) The date is set back to today even if a DATE command preceded (see Section 1.4.6)

and

2) The program goes back to terminal mode even if it was processing in file mode (see Section 1.7.2).

1.4.5 The Control Shift

As you have come to expect from using typewriters, computer terminals have a shift key allowing the change from lower to upper case letters and numbers. The AFFIRMS program is case blind--that is, it makes no difference if it receives a "B" or a "b", the same action results. It is usually most convenient to set the keyboard so that shifting isn't required to send the numerals. By setting the character switch, it is possible to get both capital letters (easy to read) and numbers without shifting back and forth.

Unlike a typewriter, terminals have a second shift. It is called the CONTROL shift and will usually be located above the lefthand regular shift. By holding this key down and typing with the other hand, a series of nonprinting control signals can be sent. These control signals are identified by the strange 2- and 3-letter abbreviations on some of the otherwise normal keys.

AFFIRMS only uses one of these control functions, that is the control "CAN" or control "X". Hitting this key allows the line you are presently typing to be destroyed and retyped without returning to the "COMMAND?" prompter. This technique is particularly useful while constructing files since it permits limited repairs without having to start the entire file over.

***-NOTE: THE REMAINDER OF SECTION 1.4 SHOULD BE SKIPPED
UNTIL SECTION 1.5 HAS BEEN STUDIED.

1.4.6 Changing the System Date--the DATE Command

The DATE command permits the system date to be overridden for the extent of a series of FCST, ZONE, OBS, or ARCH commands. A DATE command must be followed by a FCST, ZONE, OBS, ARCH, STOW, or BYE command. If not, a message is issued, and AFFIRMS requests the entry again.

The DATE command takes 3 operands:

Year;	A 2-digit number (e.g., 72 for 1972)
Month;	A 2-digit number (e.g., 08 for August)
Day;	A 2-digit number (e.g., 03 for the third)

As soon as the Break-Key is hit, the date automatically reverts back to today's.

An example of a DATE command:

```
COMMAND?DATE 72,03,27
EXC04I DATE OVERRIDDEN 72/03/27
```

If a FCST command were now entered, the data would be considered by AFFIRMS to apply to March 27, 1972, rather than the current date.

The DATE command is of particular interest to fire-weather forecasters. They frequently want to update their forecasts in the morning utilizing yesterday afternoon's observations. By entering a DATE command which specifies yesterday's date, followed by a ZONE command, the trends specified will be applied to yesterday's observations and forecasts will be generated with today's date. (If the DATE command were not used, AFFIRMS would look for observations dated today which would not be available in the morning.)

1.4.7 Displaying "Stale" Data--The SET DAYS Command

Sometimes you may wish to display stale data from stations which have not currently reporte that is, observations not dated today or forecasts dated tomorrow. The SET DAYS command allows you to do this. However, recall that AFFIRMS only holds the most current data in accessible storage. Today's OBS destroys yesterday's OBS.

The SET DAYS command has the form:

```
SET DAYS nn
SET DAYS o
```

Where nn indicates how many days you want the computer to look back for data in subsequent displays. You may use any number from 0 to 31 or -1. A value of 2 will cause data for today or up to 2 days earlier to be displayed. A value of zero cancells previous SET DAYS commands.

To limit displays of forecasts to tomorrow's forecast only, a value of -1 can be used. If the DSPU command is used and tomorrow's forecast DSPU is desired rather than the forecast for today, the SET DAYS -1 must be used.

***-Note: AFFIRMS shows only the latest data entered. SET DAYS simply allows you to igno or accept stale data as you wish.

1.4.8 Suppressing Display Headings--The SET HEAD Command

Another type of SET command is SET HEAD. This command allows you to control whether headings will appear above data listed with the DSPW, DSPI, DSPX, or DSPU commands. For example, if you were doing several DSPW displays, you could allow the heading on the first one and turn off the headings on the subsequent ones. This saves both time and computer costs, however, it takes the savings from three or more headings to offset the cost of processing this command. The SET HEAD command takes two forms:

SET HEAD OFF;	Headings will not be printed on subsequent displays.
SET HEAD ON;	Headings will be restored on subsequent displays.

1.4.9 Displays with Station Names--The SET NAME Command

The AFFIRMS program is structured to begin each line of display with the six-digit station number. If the user's operation is better served by a display identified with the station name, this number can be replaced with a six-letter abbreviation of the name. This command has the form:

SET NAME ON;	Each display line starts with the name
SET NAME OFF;	Each display line starts with the number

1.4.10 Requesting Statistics on DSPW Displays--The SET MEDIAN and SET MEAN Commands

A pair of SET commands exists to allow the user to get both the median and/or the mean values of the weather elements displayed with the DSPW command. They have the form:

SET MEDIAN ON;	Median values follow the display
SET MEAN ON:	Mean values follow the display

Both of these commands are terminated by the command SET MEDIAN (or MEAN) OFF, or when the session ends.

If the SET commands precede a DSPW OBS or DSPW SPC in which the data from at least 3, but no more than 20 stations is retrieved, the median or mean values of dry bulb temperature, relative humidity, windspeed, maximum and minimum temperatures, maximum and minimum relative humidities and precipitation duration are printed out at the bottom of the display.

The median value is defined as "that value above and below which an equal number of observations will be found when all of the observations are arranged in order of magnitude." The mean is "the average numerical value of the set."

1.4.11 Mixing SET Commands

To save typing required of both the system and the user, all SET commands can be combined on one line. The only rule is to retain the pair(2) type structure. For example:

```
SET NAME ON,DAYS 5,HEAD OFF,MEAN ON
```

This example is perfectly legal and is interpreted by the computer as:

```
SET NAME ON
SET DAYS 5
SET HEAD OFF
SET MEAN ON
```

***Note: Other SET commands used by states or other large areas are illustrated in Section 4.1.

1.5 ** DISPLAYING WEATHER AND FIRE DANGER INFORMATION **

The commands used to display weather and fire danger ratings are of the form:

```
VERB TYPE,SCOPE,nnnnnn,mmmmmm
```

***The SET commands influence the content of displays. See Sections 1.4.7-1.4.11 and 4.1.1-4.1.3.

1.5.1 Displaying Station Weather and Fire Danger Information-- The DSPI, DSPW, and DSPX Commands

The command VERB determines if weather or computer fire danger indices are displayed. Three verbs are used:

DSPW; The W indicates a weather display (weather).
DSPI; The I indicates a fire danger rating display (indices).
DSPX; The X indicates an abbreviated fire danger rating display.

TYPE specifies whether observed or forecast data is to be displayed. Three operands are used:

OBS;	Weather or fire danger data derived from the regular, scheduled fire weather observation.
SPC;	Weather or fire danger data derived from off-time or off-site weather observations
FCST;	Predicted weather or fire danger ratings.

The second operand, SCOPE, specifies what geographical or political criteria are to be used in selecting the data to be displayed. Only those stations which meet your criteria will appear in the output. Nine operands are available to specify the scope of the display:

REG;	U.S. Forest Service Region, or Regions
STAT;	State
CNTY;	County
ZONE;	Fire weather zone
SIG;	Special-Interest-Group (S.I.G.)
ID;	Single station or range of stations
FOR or UNIT;	National Forest or administrative unit
LIST;	List of specific station numbers

The third and fourth operands (nnnn... and mmmm...) are used to indicate which region, which range of stations, which county, etc. that the scope operand is specifying.

You may use any combination of verb, type, and scope to create any selection criteria you wish. Below are some examples of the more commonly used combinations:

```
DSPW OBS,ID,020503          (Display OBS weather for station number 020503 only.)
DSPI SPC,ID,201009,495689   (Display SPC indices for all stations with numbers
                                between 201009 & 495680.)
DSPW OBS ZONE 303 3         (Display OBS weather for all stations within fire
                                weather zone 303 in Region 3.) Note that both the zone
                                number and Forest Service Region number must be entered.
```

```
DSPW,FCST FOR,KOOT, 1      (Four letter abbreviations for units and Forests are found
                              in the  USERLIST, Section 1.2.7.  Note that Forest
                              Service Region number must be entered.)
DSPI OBS,UNIT,CBLM,2       (Display  OBS indices for BLM stations in the Colorado BLM,
                              Forest Service Region number must be entered.)
DSPI FCST,STAT,29          (Display  FCST  indices for stations in state number 29.)
DSPI OBS,CNTY,2920         (Display  OBS  indices for stations in county 20 of state 29.)
DSPW FCST,REG,3,4,5        (Display  FCST weather for stations located in Regions, 3,4,5.)
DSPX OBS,SIG,006           (Abbreviated display  OBS  indices for those stations
                              previously placed in S.I.G. 006.)
DSPW OBS,LIST,020202,045691,292001,045302,045228    (Display  OBS  weather for the
                              listed stations - up to 18 numbers can be entered.)
```

***Note: Each fire weather station has been assigned a 6-digit identifier code by the National Weather Service. The first 2 digits indicate the state; the second pair, the county; and the third pair, the specific station within that county.

1.5.2 Examples of Display Headings/Formats

There are four display formats. Examples of the display headings are:

DSPX OBS, DSPX FCST, or DSPX SPC

```
----------05/01/74---------OBS---------13:19GMT-------
STA-NO MS DY HR LR MR  IC  SC  EC  OI  BI  FLI  MC  AC
```

DSPI OBS, DSPI FCST, or DSPI SPC

```
----------------05/01/74-----------OBS-----------13:20GMT--------------
STA-NO MS DY HR DBT RH WS LR MR HB V FF 10  100 IC SC EC OI BI FLI MC AC
```

DSPW OBS, or DSPW SPC

```
----------------05/01/74-----------OBS---------13:22GMT-------------
STA-NO DY HR W DBT DPT  RH YL ML DIR WS 10  TMX TMN HMX HMN PD PPTAMT
```

DSPW FCST

```
----------------05/01/74------FCST--------13:22GMT----------
STA-NO DY HR W DBT DPT  RH AL TL DIR WS TMX TMN HMX HMN P1 P2
```

***Note: Due to space limitations, the maximum value for RH, 10, LR, MR, IC, SC, EC, OI, BI, and FLI in the DSPI display is 99.

Abbreviations used in the displays are shown below:

AC;	Adjective class of day (See Appendix C)
AL;	Predicted LAL for the current calendar day from observation time until midnight (Afternoon)
BI;	Burning Index
DBT;	Dry-bulb temperature
DIR;	Wind direction
DPT;	Dew point
DY;	Day of month
EC;	Energy Release Component
FF;	Fine fuel moisture
FLI;	Fire Load Index
HB;	Herbaceous vegetation condition
HMN;	24-hour minimum RH
HMX;	24-hour maximum RH
HR;	Hour valid time
IC;	Ignition Component
LR;	Lightning Risk
MC;	Manning class of day (See Appendix B)
ML;	Observed LAL from midnight to current observation time (Morning)
MR;	Man-caused Risk
MS;	Model-slope class
OI;	Occurrence Index
PD;	Observed 24-hour precipitation duration
PPTAMT;	Observed 24-hour precipitation amount
P1;	Predicted precipitation duration, first 16 hours after current day's OBS time
P2;	Predicted precipitation duration, remaining 8 hours of 24-hour period
SC;	Spread Component
STA-NO	Station-number
TL;	Predicted LAL for Tomorrow
TMN;	24-hour minimum temperature
TMX;	24-hour maximum temperature
V;	Woody vegetation condition
W;	State of weather
WS;	Windspeed
YL;	Observed LAL for the previous day (Yesterday)
10;	10-hour timelag fuel moisture (measured or computed stick moisture content)
100;	100-hour timelag fuel moisture

1.5.3 Displaying Weighted Average Fire Danger for a Protection Unit -- the DSPU Command

The DSPU command allows the AFFIRMS user the flexibility to produce a display of the weighted fire danger information associated with up to nine individual stations. This command provides a mechanism for the user to consider the relative importance of all the available stations in the area of interest and to produce a single integrated display of the fire danger on that area. See Appendix E for details on the DSPU weighting method.

The command has the form:

```
DSPU TYPE,REGION,STA-NO-MODEL-SLOPE,WEIGHTING FACTOR
```

In which:

Type; OBS, SPC or FCST (See 1.5.1)

Region; A one- or two-digit USFS Region number in which all the stations which follow are found.

Sta-No-Model-Slope; 8 characters: 6 for station number, 1 for fuel model, 1 for slope class. A maximum of 9 stations is allowed.

Weight; A one- or two-digit number indicating the percent of the final rating that this station is to contribute.

For example:

```
COMMAND?DSPU OBS 5,045408G2 20,045409I3 25,045413A1 15,&
OK MORE?045110B3 30,045414B3 10
```

When preparing this command, check to insure that the sum of all the weighting factors is 100%. In the event that one or more of the stations cited in the command lack current OBS, SPC or FCST information required for the execution of the command; the computer will automatically take action. The existing stations will have their weighting increased proportionately to once again total to 100%. Whenever this re-weighting is done, a message will be issued warning the user that the display is based on fewer stations than he intended.

It is possible to request a DSPU at a time when some of the requested stations have a forecast for today and others have for tomorrows forecast. To prevent a weighted product for two different dates, the SET DAYS command (See Section 1.4.7) takes on a new significance. Without a SET DAYS command the program will select those stations with a forecast valid for today. If tomorrows forecast is desired, a SET DAYS -1 is required.

Since the same station can be called in any number of different DSPU commands and assigned different weighting factors, no station group facility like the S.I.G. (see Section 1.6) has been provided. To avoid the tedium of typing in several DSPU's each day with all the associated station data, create a command file (see Section 1.7) to be executed each day.

If two command files had been created earlier with DUOBS700 containing the above example and DUFST700 requesting forecasted DSPU's, the following example might result:

```
HH
U#=LAN68700,LOOKIE,STR

NFDR AFFIRMS (RSH:335/59/ 5/15)
FOR AID, ENTER: HELP ..OR CALL (208) FTS 588-9286 COM 345-3564

COMMAND?FILE READ DSPU700

FIL02I NOW EXECUTING FILE /DSPU700
--07/24/75--OBS---22:35MGT--
     DY   IC   MC   AC
----------------------------

     24   27   3+   M

SYN06I END-OF-FILE ENCOUNTERED


COMMAND?SET DAYS -1

COMMAND?FILE READ FSTDU700


FIL02I NOW EXECUTING FILE 'FSTDU700'
--07/24/75--FCST--22:36GMT--
     DY   IC    MC    AC
----------------------------

     25   46    4-    UH

SYN06I END-OF-FILE ENCOUNTERED

COMMAND?BYE

SESSION COST:  $  .40

0003.71  CRU     0000.01  TCH      0000.41   KC

OFF AT 15:35MST  01/24/75
```

In the above example, we obtained a DSPU for observed weather and a second DSPU for tomorrows forecast weather. Note that the displayed manning classes always use the 9-class system (See Appendix C).

1.5.4 Comparative Efficiency of Display Options

Users should be aware of the varying costs of the display options. The following list is in order of increasing costs (decreasing efficiency). The display scopes grouped in parantheses are equally efficient:

(REG,ZONE,STAT,CNTY,ID,LIST)SIG,(FOR,UNIT)

The FOR and UNIT scopes should be avoided when possible since they require the most computer time and, therefore, result in the highest cost to the user. This does not mean that you should never use them, rather they should not be adopted for day-to-day routine operations. The SIG scope joins the lower cost group if it contains five or more stations.

1.6 ** THE SPECIAL INTEREST GROUP **

Frequently, users of AFFIRMS will find that they wish to display data from several stations which do not conform to any geographical or political grouping. A typical example would occur on the Tahoe National Forest in California. This forest adjoins the Toiyabe National Forest which is in a different region. The use of a display by forest would, because of the extent of the Toiyabe, supply more data than the Tahoe would probably want to see. In such a case, a user would create a list of stations from both forests; such a list would be called a special interest group (S.I.G.).

1.6.1 Locating a Free S.I.G. Number-- The SIG 999 LIST Command

S.I.G.'s are identified with a 3-digit number. Since the groups are constructed in a random manner by the various AFFIRMS users, it is not obvious which S.I.G. identifiers are free. To locate a vacant S.I.G., enter this command:

```
COMMAND?SIG 999 LIST
INT111 AVAILABLE GROUP:  23
```

In this case, the computer has indicated that S.I.G. 023 is available.

*** Note: The computer will not print a leading "0" but the "0" must be entered by the user e.g. use 023 for the SIG commands.

1.6.2 Maintaining the S.I.G.--The SIG Commands

The SIG verb is used for maintaining a special interest group. One can: 1) add stations to the group, 2) delete stations from the group, 3) empty the group, or 4) list out the group.

The forms of the command are:

`SIG nnn,ADD,M1,M2,M3,......;`	Where nnn is the S.I.G. number, M1,M2,... are 6-digit station numbers to be added to the S.I.G.
`SIG nnn,DEL,M1,M2,M3,...;`	Where the M1,M2... are station numbers to be deleted.
`SIG nnn,LIST;`	The stations in the S.I.G. are listed.
`SIG nnn,CLR;`	All stations are removed from the group, and the owner's jurisdiction over the group ceases.

The S.I.G. number (nnn) must be 3 digits long (e.g., 004).

If an SIG nnn ADD .... command is entered for a S.I.G. which is not already assigned, the S.I.G. is automatically assigned. If the S.I.G. is already owned, a message will notify you.

Requests to 1) delete stations not in the list, and 2) add stations already in the list, will be ignored--no message will be given.

If you attempt to expand a S.I.G. to more than 20 stations, as many stations as can be accommodated will be added; the rest will be ignored. You can determine how many stations in your list were actually added because the up-arrow will indicate the first station which was **NOT** accepted from the ADD command.

If you list out a group and there are no stations in it, you will receive the message: "GROUP EMPTY". If the group is not owned, you will get: "GROUP UNASSIGNED".

1.6.3 Example of Setting up a S.I.G.

Here is an example of setting up a special interest group; the comments after each command describe its function:

```
COMMAND?SIG 999,LIST  (Asking for the number of a free group)
INT11I AVAILABLE GROUP:   5

COMMAND?SIG 005,ADD,020209,021201   (this makes the S.I.G. "yours")

COMMAND?SIG 005,LIST   (Checking the contents of the S.I.G.)
INTEREST GROUP CONTAINS THESE STATIONS:
020209 021201

COMMAND?SIG 005,DEL,021201,020209   (Deleting two stations)

COMMAND?SIG 005,LIST    (Again, checking the contents)
INT04I GROUP EMPTY

COMMAND?SIG 005,CLR    (Freeing the group back to the pool)

COMMAND?SIG 005,LIST   (The S.I.G. should now be free)
INT07I GROUP UNASSIGNED
```

1.7 ** FILES **

Files are created to make use of the computers memory capabilities. Either messages which can be transmitted to other users (text files) or frequently used series of AFFIRMS commands (command files) are stored. You may create files (FILE MAKE), view the contents of a file (FILE LIST), execute the commands in a file (FILE READ), or delete a file from the computer (FILE PRGE). Only the creating user may purge a file. For instance, a fire weather narrative can be placed in a file, then any user can view the file by using a FILE LIST command. The same user may have created a file containing the commands needed to display fire danger indexes; a FILE READ command is used to execute the commands in this file.

1.7.1 Generating a File--The FILE MAKE Command

In order to generate a file, respond to the computer's prompter, COMMAND?, by typing FILE MAKE and a carriage return. The computer will then ask you for a name for a file by typing FILE NAME?. Type in a name and hit the carriage return.

File names must be 4 to 8 characters in length, with the last 3 digits of your user number as the last 3 characters of the file name. For example, user number UAN68552 might make a file called JUNK552 or JU552 or even just J552. Using the last 3 digits of the user number in your file names assures that you will not select the same file name as another AFFIRMS user. Never use blanks, commas, periods, or any other special characters as part of a file name. File names beginning with FWX are exempt from the user number requirement.

After you have supplied a file name, AFFIRMS will instruct you to enter the information you wish stored in the file, one line after the other. When you have no more to enter, hit the Break-Key after the last carriage return. See 1.3.2 for instructions on whole line repair.

Example:

```
COMMAND?FILE MAKE
FILE NAME?HEF309
FIL11I HIT 'RETURN', THEN 'BREAK' AFTER LAST LINE OF TEXT
READY FOR INPUT
JUNE 25/1300MDT

BOB, WHENEVER YOU ROUTE A MESSAGE TO THE FORECASTERS, INCLUDE NUMBERS 005 and 010.
```

***Note: If you try to make a file with the same name as one you already have stored, a message will tell you so. You will be allowed to overwrite your old file with new text if you answer the question with YES. Note that the new text would replace the old text; it is not added to the existing old text. If you type NO, the computer will return to the COMMAND? point and you must start over with a new FILE MAKE and another file name.)

(Each of these lines was ended with a carriage return. The Break-Key was hit after the file was completed.)

1.7.2 Viewing the Controls of a File--The FILE LIST Command

Once a file has been created, it's contents can be reviewed with the FILE LIST command. The only requirement is that the user be able to supply the FILE NAME.

Example:

```
COMMAND?FILE LIST OBS709
```

(At this point the computer will print a complete copy of what user number 709 typed into FILE OBS709.)

Frequently used FILE LIST commands that do not follow the general rules stated in 1.7.1 are:

FILE LIST BLURBS	See Section 1.2.6
FILE LIST NETSCHED	See Section 1.2.4
FILE LIST USERLIST	See Section 1.2.7
FILE LIST FWX*nnn*	See Section 3.1.6
FILE LIST ARCHSTAT	See Section 4.2

1.7.3 Entering Commands from a Command File--The FILE READ Command

A file can consist of a series of valid AFFIRMS commands; such a file would then be a command file. If the file is executed using the FILE READ command, AFFIRMS takes its commands from that file instead of your terminal's keyboard. One might construct a file containing several display commands. Then, by entering a FILE READ command, the stored commands would be processed one after the other. If this list of commands were needed every day, you would save the trouble of typing them each time they were needed.

Example:

```
COMMAND?FILE MAKE
FILE NAME?R3WEA300
FIL11I HIT 'RETURN', THEN 'BREAK' AFTER LAST LINE OF TEXT
READY FOR INPUT

SET NAME ON
DSPI OBS STAT 29
DSPI OBS STAT 02
```

Then, each day, instead of entering those three commands separately, you could enter:

```
COMMAND?FILE READ R3WEA300
FIL02I NOW EXECUTING FILE 'R3WEA300
```

AFFIRMS would execute the three commands in sequence.

1.7.4 Producing Headings from a Command File -- The *

Whenever AFFIRMS receives a typed line preceded by an asterisk, *, it parrots it right back on your printer. In this way you can insert special comments or headings on output. This procedure consists of creating a command file which contains the needed commands with heading and comment lines inserted. The location of these marked lines in the file determines where they will appear on the output. For example:

```
*HERE IS A DISPLAY OF THE OBSERVED WEATHER AND INDICES FOR ARIZONA
DSPI OBS STAT 02
*THE FORECASTED FIRE DANGER INDICES FOR REGION 9 ARE:
DSPX FCST REG 9
```

The two displays obtained with this command file will appear with those headings.

1.7.5 Obtaining a List of Saved Files--The FILE NAMES Command

Users commonly lose track of files which they have saved. There are two ways to obtain a list of the files saved under your user number.

1.7.5
1.7.6
1.7.7

The first is automatically printed on Mondays with the BYE when you sign off. The computer will respond as follows before disconnecting your terminal:

```
COMMAND?BYE
       SAVED FILES, USER NUMBER AN68709
       05/01/74          TIME16:42GMT


       HELF709     1 MAY    R3709    29 APR
       HELF2709    1 MAY
```

***-Note: The dates following the file name are the last time that file was used. Every file listed here costs $1.10 per month; therefore, every Monday when AFFIRMS automatically produces this display you should check these dates and purge any obsolete files that exist.

The second command is FILE NAMES. The computer will react as if BYE were typed on Mondays except instead of disconnecting the terminal, you will be returned to the COMMAND? point after the accounting is printed.

1.7.6 Purging a File--The FILE PRGE Command

To remove a file from the computer the FILE PRGE command is used. Only the user that created a file may purge that file. An example command is:

```
COMMAND?FILE PRGE R3WEA300
```

1.7.7 Summary of FILE Commands

FILE MAKE;	Specifies that you are going to generate a text file.
FILE LIST;	Specifies that you want the contents of a text file printed.
FILE READ;	Specifies that commands are to be read directly from a text file, instead of the keyboard.
FILE NAMES;	Specifies that you want a list of the names of text files saved under your user number.
FILE PRGE;	Specifies that you wish a file purged (removed from storage).

1.8 ** ROUTED MESSAGES **

A very useful administrative feature of AFFIRMS permits any user to route a message to as many as 20 other users in the AFFIRMS network. The procedure consists of putting a message in a text file and instructing the computer to print out that file automatically when a particular user signs on.

When any user signs on to AFFIRMS, his user number's last 3 digits are checked to see whether they appear in that special route-list--a list that is generated by the message originator. If the user's number is found in the list, he receives a copy of the message and his number is automatically removed from the list. Therefore, he receives the message only once.

1.8.1 Sending a Message--The POST Command

An example of the POST command is:

```
COMMAND?POST ℓℓℓ,mmm,nnn,.........
FILE NAME?HELF009
```

where ℓℓℓ,mmm,nnn, etc. are the last three digits of the user numbers which are to receive the message. You can specify up to 20 numbers to this route list. The same user number may be entered more than once in the list; this causes multiple postings of the message to that user before the post is satisfied. The user numbers may be found in the USERLIST explained in Section 1.2.7.
After you have entered a POST command, AFFIRMS will ask for the name of the file to be sent. It must be a file you have already created. In the example, the message was contained in the file HELF009.

Only one route-list for a specific file name may be in effect at any one time. Entering a POST command that cites a file which is currently posted simply overrides the earlier posting request and produces a new route-list.

It is permissible for one user to enter a POST command which cites a text file owned by another user. However, if the owner of the file purges it before everyone on the route list receives it, these late comers will only get an error message.

1.8.2 Removing a File from the Route-List

Entering a POST command with no user number specified causes the computer to erase the route-list for that file.

Example:

```
COMMAND?POST
FILE NAME:HELF009
```

Since no user numbers followed the verb, POST, the route-list for HELF009 is deleted.

-Note: The text file cited by a POST command is ***NOT automatically purged when the post is satisfied. The posting user has this responsibility. In other words, in this example, the text file HELF009 is retained until eliminated by the FILE PRGE command (Section 1.7.5).

1.8.3 The Route-List

If you enter a POST command without specifying a user number or file name, a summary of posted files and route-lists will be printed out on your terminal. Remember that as each user in a route-list receives the message, his user number is removed from the route-list. By examining the route-list, one can determine which addressees have and have not received the message.

Example:

```
COMMAND?POST
FILE NAME?       (Do not answer - just hit Carriage Return)

EXC07I FILE /NEWD509   POSTED ON 750503
FROM USER NO. 509 to:  503 504 505 506 508
```

File NEWD509 was posted on May 3, 1975, by user number 509. Users 503, 504, 505, 506, and 508 have not yet received it. If other files had been posted and not yet received by all the users on their respective route-lists, the above example would have included all of them.

1.9 ** MANAGING COSTS

In almost every operation certain overhead costs exist. This same general rule applies to computer operations as well. This basic rule has two cost impacts on the AFFIRMS user. First, if a toll telephone call is required to reach the computer port, a base minimum fee for 3 minutes is charged by the telephone company even if the session is completed in less than that time. The second overhead charge of approximately $.30 is involved in just signing on and off the G.E. Timeshare System. Since the telephone charge is quite variable depending on location, it has not been included in the following examples. The base computer charge on the other hand is included in the figures used below.

Several factors determine cost of inputting data and commands into AFFIRMS. The first is the number of operations sharing the overhead charges mentioned above. Signing on to enter the fire weather observations for one station is more expensive on a per-station basis than signing on to enter data for 6 to 10 stations. The second point involves the time it takes the operator to complete the session. Time affects both of the general charges. The telephone cost is figured on a 3-minute minimum and each additional minute after that. The computer service, on the other hand, charges a flat rate of $.116 per minute. Therefore, the sooner the session is completed, the lower the resulting cost. Several techniques are available which will decrease the time on the terminal. These remarks are aimed at particular groups of users. Therefore, consider each logically before considering their use in your particular application.

Output

Using Command Files: Once these files have been organized, the user references the file name with a FILE READ command. The computer is able to recall the file's contents and execute the commands found there. Each command entered in AFFIRMS has an associated cost. Therefore, the contents of the file must be large enough so that the saving in reduced typing time offsets the cost of the FILE READ command. If the operator is a fair typist, the command files need to be about 10 lines long to make the command file pay. However, the convenience of automatic operation might well justify files of only three lines. Finally, remember that each file costs $1.10 per month as a minimum.

Using Paper Tape: If your terminal has a paper tape unit, the same saving is possible as with command files. Actually, this method will be less expensive since no files are stored at $1.10 per month and processing of the FILE READ command is not required. The tape is started and stopped automatically by the computer as it reads one command at a time. These tapes should be prepared on plastic film rather than the more easily damaged paper since they will be used over and over.

Selecting Display Commands: The relative efficiency of the different options for the display scope is discussed in Section 1.5.4. However, there are other factors to consider. To minimize cost you should display only the data you need with the fewest possible number of the most efficient commands.

For instance, by using the DSPX instead of the DSPI command 20 characters less per line are printed. So, if the DSPX contains sufficient information, use it.

Let us say that you are interested in 10 stations--5 on your Forest and 5 on adjacent BLM land. Creating either a S.I.G. of 10 stations or using the LIST scope option would result in a cost of $.82 if a DSPX command is used. On the other hand, if you displayed 5 with one command and then the others with a second, the cost would be about $1.23. The saving amounts to about $40 for a 100-day season when one display command is used instead of two.

The cost of the DSPU displays is calculated in a completely different way since only one line of output is produced. The base cost is approximately $.25 for a DSPU of two stations. For every additional station add $.04. For instance, a 9 station DSPU costs $.25 + 7(.04) = $.53.

Input

OBS, FCST, and ZONE commands can be entered using magnetic tape (via a command file, Section 1.7.2) or paper tape. The above comments concerning the utility of using these two media apply here, too. But, since the OBS, FCST, and ZONE commands change daily, a new tape must be made every day. Tape making and correcting is an art in itself, so a fair test of tape as an entry method will require considerable skill development before a valid comparison against keyboard entry can be made. The skill of the operator will determine that point where the volume of data to be entered will make using tape pay. For a good typist who is proficient at making tapes, our experience is that the break-even point averages about 10 lines of input. If your input is more than 10 stations, a tape prepared and checked for errors "off line" will usually prove a better buy than "on line" keyboard data entry.

2. USING AFFIRMS -- THE FIRE MANAGER

2.1 ** THE STATION CATALOG **

The catalog is a data file maintained by the user which contains permanent and semi-permanent information about each of his fire-danger rating stations. By storing such information in the catalog, you are saved the trouble of repeatedly supplying it when you enter observations for that station. A station must be cataloged before weather data may be entered for it.

A station may be cataloged at any time, even weeks or months before it is ever actually referenced. In normal use, a station will be cataloged once prior to the first time that observations are entered for it.

Once a station is cataloged by a particular user, no other user may modify or destroy that station entry. Any user, however, can simply inspect a station catalog with the DESC command.

2.1.1 The Initial Catalog Entry--The CTLG Command

The CTLG command makes the initial catalog entry for a station.

The following list contains a description of the operands for the CTLG command in their order of entry:

ID;	The 6-digit numerical station identifier. Obtain number from fire weather forecaster. Ninety series stations are not archived.
ELEVATION;	Feet above sea level, 1-5 digits.
TIME ZONE;	The standard time zone in which the station is located (BST, HST, YST, PST, MST, CST, EST, AST)
FOREST OR UNIT NAME;	A 4-letter code for the National Forest or administrative unit in which the station is located. Forest names are to be represented by the first four letters or a phonetic abbreviation. BLM units can be shown as the first letter of the state and then BLM. BLM units in Nevada would then be NBLM.
REGION#;	The U. S. Forest Service Region number in which the station is located (1-10). Enter the number even if the station is run by an agency other than the Forest Service.

OBSERVING AGENCY; A 1-digit code indicating the agency which operates the station. Use the following table:

1 Forest Service
2 Bureau of Land Management
3 National Park Service
4 Bureau of Indian Affairs
5 State Agency

6 City or County Agencies or Special Districts
7 Private or Commercial
8 Other Federal Agencies
9 Unknown

STANDARD OBS TIME; A 2-digit number indicating to the nearest hour, the time at which the station normally takes fire weather observations (e.g., 15 for 1500 hours). The time-of-observation entered in OBS and ARCH commands will be required to be within 2 hours of this standard observation time. Remember, Standard, not Daylight Savings Time.

FIRE WEATHER FORECAST ZONE; A three-digit number (001-999) assigned and used by the National Weather Service to designate the fire-weather forecast zone. The first digit corresponds with the Forest Service Region number (e.g. 503 is a fire weather zone in California).

STATION NAME; An entry of one to six alphabetic characters. It can be the complete or abbreviated name of the fire weather station. If any doubt exists about the clarity of the abbreviation, use all six letters.

If you refer to an already cataloged station in a CTLG command, the message CATALOG SUBSTITUTION is given. The net effect of such a recataloging is 1) the station's catalog entry is destroyed, 2) any current OBS, SPC, or FCST data for that station is destroyed, and 3) the command is processed and a new catalog entry created.

***-Note: A station catalog-entry is not complete until the HDEF, OPT, MODL, HERB, and WOOD commands have also been given for that station. This must be done when initially cataloging a station, or when making a catalog substitution (recataloging).

The NAME and FWXZ commands allow modification of the fire weather zone or station name without recataloging.

Example of CTLG command:

```
COMMAND?CTLG 020202 6800 MST KAIB 3 1 13 308 MEADOW
```

This station's ID number is 020202; it is at an elevation of 6800 feet; in Mountain Standard Time Zone, on KAIBAB NF, in Region 3. Regular fire weather observations are taken by the Forest Service at 1300, and this station is part of Fire Weather Zone 308. The name of this station is Meadow.

2.1.2 Specifying the Humidity Variable--The HDEF Command

The HDEF command identifies the type of moisture-variable which AFFIRMS is to expect in OBS, SPC, or ARCH weather data from that specific station. Two operands are used with HDEF:

ID;	The 6-digit station identifier
HUMIDITY CODE;	A 1-digit number indicating the moisture variable to be entered. 1 = Wet-bulb temperature (Deg. F) 2 = Relative Humidity (percent) 3 = Dewpoint temperature (Deg. F)

The HDEF command must be given sometime between the time that a station is cataloged (or recataloged) and the first time that OBS, SPC, or FCST commands are used for that station.

The humidity variable specification may be changed at any time, as desired.

An example of the HDEF command:

```
COMMAND?HDEF 020202 1
```

We have specified that station 020202 will enter wet-bulb temperature.

2.1.3 Specifying the Manning Index and Data Option--The OPT Command

The OPT command is used to tell AFFIRMS what type of observational data is to be entered and which NFDRS index or component is to be the basis for manning, the Manning Index (MI). The OPT command requires three operands:

Any time that a MODL command is entered, it completely obliterates any previous model specification. The herbaceous and woody vegetation conditions are also erased. Therefore, the HERB and WOOD commands must be entered anew anytime that a MODL command is used.

***-Note: The Bureau of Land Management is using the 80th and 95th percentiles of the Burning Index. The U.S. Forest Service, the 90th and 97th percentiles. If your agency mans on an index different than the BI, enter the appropriate percentile values for that component or index.

2.1.5 Specifying the Herbaceous Vegetation Condition--The HERB Command

The HERB command permits you to pre-specify the herbaceous-vegetation-condition for each fuel model used at a given station. The specifications can be changed any time as needed. However, before fire indices can be computed for a given model at a station, an HERB command must have been entered for the model. The operands of the command are:

ID;	The 6-digit station identifier
MODEL-NAME;	A 1-letter code for the fuel model which has been previously cataloged for this station
HERBACEOUS VEG. CONDITION;	A value from 0 to 97% that represents the percent of fine fuels that are living.

To specify values for more than one fuel model, repeat the fuel model name-herbaceous condition operands. For example, if a station used models C and H, we could specify herbaceous conditions of 26 for the C model and 40 for the H model like this:

```
COMMAND?HERB 020209 C 26 H 40
```

The order of the fuel models is not important. Also, one or more conditions can be specified without affecting those previously specified for the other fuel models.

2.1.6 Specifying the Woody Vegetation Condition--The WOOD Command

The WOOD command is very similar to the HERB command, except that it is used to specify the woody vegetation condition for each model for a station. It is used in identically the same way as the HERB command, except that the woody vegetation code is entered instead of the herbaceous condition-- the values must be a 1-digit number; 5, 7, or 9 only. See RM-84 for an explanation of these codes.

The WOOD command is required only if fuel models with live woody fuels are involved (Models B and F). An example of the command is:

```
COMMAND?WOOD 020202 B 7 F 9
```

In this example we assigned a code 7 to Woody Vegetative Condition to Fuel Model B and a code 9 to Fuel Model F.

2.1.7 Listing the Station Catalog --The DESC Command

The DESC command causes the catalog for a specified station to be printed out at your terminal. The command takes one operand, the 6-digit station identifier. An example of a DESC command:

```
COMMAND?DESC 020202

STATION 20202 MEADOW:CATALOG ENTRY (V:4/7) CONTAINS:
USER-NUM=811,ELEV= 6800,AGENCY=FOREST SERV,REG=3, UNIT=KAIB
TIME=MST, OBS-TIME=1300, OPT=3, HUM-ENTRY=WET-BULB, FWX-ZN=8
MODELS:        C          H
SLOPE;         3          2
HERB.-VEG
COND:         26         40
WOOD-VEG
COND:          0          0
(9) BI
LEVELS:      24/40      12/17
```

The description indicates the last modification date (month/day), and the last three digits of the owner's user-number, 811.

2.1.8 Removing a Station Catalog--The DEL Command

Do not delete your station catalogs at the end of each fire season! It is cheaper to leave the catalogs in the computer. The cost of catalogs is paid as a part of the AFFIRMS overhead costs.

The DEL command is used to remove a station from the catalog. The command takes just one operand, the 6-digit station identifier. An example of the DEL command:

```
COMMAND?DEL 292503
```

We have requested that the catalog for station 292503 be removed from the AFFIRMS data file. Any reference to this station will now be cited as an error.

When the catalog entry is deleted, any current OBS, FCST, or SPC weather-and/or-indices for that station will also be deleted from the C.O.F.

***-Note: If a station is deleted and then recataloged with the CTLG command, the OPT, HDEF, MODL, HERB, and WOOD commands have to be re-entered.

2.1.9 Adding or Changing the Station Name -- The NAME Command

The NAME command is used when a station was cataloged without a name or if the station name has changed and a correction to the catalog is desired.

```
COMMAND?NAME 482103 FOXPRK
```

After this command is entered, a DESC of 482103 will show FOXPRK as the station name, and FOXPRK will start the display line for 482103 if the SET NAME ON command precedes a display command. Only the owner of a catalog may change cataloged data.

2.1.10 Changing the Station Fire Weather Zone -- The FWXZ Command

Occassionally the Fire Weather Forecaster will realign the boundaries of a fire weather forecast zone. At his direction the land manager operating the affected station will use the FWXZ command to make this change. The rest of the catalog is not affected. The command form is:

```
COMMAND?FWXZ 020202 308
```

Following the execution of this command, a DESC of 020202 will show a change in the FWX-ZN value. Checking the example in Section 2.1.7, the FWX-ZN value would change from 8 to 308. Also, all forecasts or observations residing in the C.O.F. will be flagged with the new FWX-ZN number..

2.2 ** ENTERING OBSERVED FIRE WEATHER DATA **

The displaying of fire weather and fire danger information, both observed and predicted, was covered in Section 1.5. However, before information can be displayed, data must be entered into the computer for storage and/or processing. Fire management is normally responsible for putting fire weather observations into AFFIRMS. AFFIRMS then does the calculations necessary to produce the fire danger ratings and makes them ready for display upon request. The fire weather forecaster would normally be responsible for putting the necessary fire weather forecasts into the computer. In this section we will look at the OBS, SPC, and ARCH, the commands used to enter the fire weather observations.

The weather data entered with OBS and SPC commands are used to compute fire danger indices. Then the weather and the indices are stored in a large random-access data file, called a Current Observation File (C.O.F.). This file is accessible to all users. The new data replace any earlier data of the same type; that is, a new OBS would override the previous day's data entered with an OBS command.

OBS and SPC entries are treated identically, except that only OBS entries are used to determine yesterday's 100-hr. timelag fuel moisture value. The AFFIRMS program recognizes that 100-hr. timelag fuels require several days to react to weather conditions. The current 100-hr. timelag fuel moisture is computed using observed weather and yesterday's fuel moisture. If the computer does not find an OBS less than 3 days old, "yesterday's" fuel moisture is set to 10% and an information message issued. When observations have not been routinely entered, more accurate 100-hr. fuel moisture values result from entering the data using the DATE command to adjust the date, then the OBS command to enter weather data. The oldest data must be entered first. (Note that this will not archive data. The ARCH command must be used to permanently store all but today's data).

To prevent unauthorized entry of observations for a station by a user who does not have jurisdiction over that station, AFFIRMS checks to insure that the user-number under which the station was originally cataloged matches that of the user who is attempting to enter an OBS, SPC, or ARCH command. The entry is ignored unless the user-numbers match.

Shortly before midnight each day, AFFIRMS automatically copies any current OBS data from the C.O.F. into a permanent archive. If archiving of non-current data is desired, the ARCH command must be used. Data entered with this command are sent directly to the permanent archive; no indices are computed, the data are not stored in the C.O.F., hence are not accessible via the display commands.

2.2.1 The Basic Fire Weather Observation--The OBS Command

OPERANDS FOR THE OBS COMMAND

Operand data	Type (see note 1)	Dec. Pt.	Min. Len.	Max. Len.	Min. Val.	Max. Val.	Missing-OK (see note 2)
Station #	Num.	No	6	6	010101	509999	Never
Obs. Time	Num.	No	2	2	01	24	Never
State of Wx. (see note 8)	Num.	No	1	1	0	9	Never
Dry-bulb Temp.	Num.	Optional	1	4	-100	136	Never
Hum. Entry (see note 3)	Num.	Optional	1	3	Varies	Varies	Never
ML (Morning's Lgtg. Act.Lvl.,note 9)	Num.	No	1	1	1	5	Never
Man Risk	Num.	No	1	3	1	100	Never
Wind Direct. (see note 4)	Mixed	No	1	3	Varies	Varies	Anytime
Wind Speed	Num.	No	1	2	0	99	Never
10-HR-T/L Moisture	Num.	Optional	1	4	0	99	MODL/OPT Dep.
Max. Temp.	Num.	No	1	3	Dry-blb	136	MODL/OPT Dep.
Min. Temp.	Num.	No	1	4	-100	Dry-blb	MODL/OPT Dep.
Max. RH	Num.	No	1	3	Obs.RH	100	MODL/OPT Dep.
Min. RH	Num.	No	1	3	1	Obs.RH	MODL/OPT Dep.
Precip. Dur. (see note 5)	Num.	No	1	3	-24	23	Never
Precip. Amt. (see note 6)	Mixed	Required	1	5	0.00	9.99	Never
YL (Previous Day's Lgtg.Act.Lvl.,note 9)	Num.	No	1	1	1	5	Never
Forecasted Man-Caused Risk (see note 7)	Num.	No	1	3	0	100	Never
UNKO (see note 10)	Mixed	No	0	8	Varies	Varies	Anytime

Because automatic archiving of OBS data takes place at 2300 MST each night, it is important that AFFIRMS users avoid entering OBS commands between the hours indicated below:

Time-Zone	Beginning	Ending
Bering Standard	7 p.m.	8 p.m.
Hawaiian Standard	8 p.m.	9 p.m.
Alaskan Standard	8 p.m.	9 p.m.
Yukon Standard	9 p.m.	10 p.m.
Pacific Standard	10 p.m.	11 p.m.
Mountain Standard	11 p.m.	Midnight
Central Standard	Midnight	1 a.m.
Eastern Standard	1 a.m.	2 a.m.
Atlantic Standard	2 a.m.	3 a.m.

2.2.2 The "Special" Observation and Archiving "Missed" Regular Observations--The SPC and ARCH Commands

OPERANDS FOR THE SPC and ARCH Commands

Operand data	Type (see note 1)	Dec. Pt.	Min. Len.	Max. Len.	Min. Val.	Max. Val.	Missing-OK (see note 2)
Station #	Num.	No	6	6	010101	509999	Never
Obs. Time	Num.	No	2	2	01	24	Never
State of Wx.	Num.	No	1	1	0	9	Never
Dry-bulb Temp.	Num.	Optional	1	4	-100	136	Never
Hum. Entry (see note 3)	Num.	Optional	1	3	Varies	Varies	Never
ML (Morning's Lgtg.Act.Lvl.,note 9)	Num.	No	1	1	1	5	Never
Man Risk	Num.	No	1	3	1	100	Never
Wind Direct. (see note 4)	Mixed	No	1	3	Varies	Varies	Anytime
Wind Speed	Num.	No	1	2	0	99	Never
10-HR-T/L Moisture	Num.	Optional	1	4	0	200	MODL/OPT Dep.
Max. Temp.	Num.	No	1	3	Dry-blb.	136	MODL/OPT Dep.
Min. Temp.	Num.	No	1	4	-100	Dry-blb.	MODL/OPT Dep.
Max. RH	Num.	No	1	3	Obs.RH	100	MODL/OPT Dep.
Min. RH	Num.	No	1	3	1	Obs.RH	MODL/OPT Dep.
Precip. Dur. (see note 5)	Num.	No	1	3	-24	23	Never
Precip. Amt. (see note 6)	Mixed	Required	1	5	0.00	9.99	Never
YL (Previous Day's Lgtg.Act.Lvl.,note 9)	Num.	No	1	1	1	5	Never

2.2.3 Explanatory "Notes" for OBS, SPC, and ARCH Commands

***-Note 1: "Type" refers to the kind of character allowed; "Num." indicates numbers only; "Alpha.", alphabetical letters only; "Mixed", numerical or alphabetical.

***-Note 2: Under "Missing OK": "Never" means the data are always required; "Anytime" means the data are not required (but may be entered, for the record); however, if it is not entered, an M must be typed in that location; "MODL/OPT Dep." means some combinations of model and option require that the data be entered (see the OPT command (Section 2.1.3) for further details).

***-Note 3: Humidity may be entered as either wet-bulb (1), relative humidity (2), or dewpoint temperature (3). The selection is made using the HDEF command. The selection once made stays in effect for all future entries until another HDEF command is given (see Section 2.1.2).

***-Note 4: Wind direction may be entered in regular 8-Pt. 1-digit form, in 16-Pt. 2-digit form, in degrees-of-the-compass 3-digit form, or in 16-point letter-codes. Thus, all of the following would give the same wind direction (the direction is stored and archived as degrees-of-the-compass):

1, 02, 045, NE.

***-Note 5: "Fuels Wet" can be indicated by entering the Precip. Dur. as a negative number. For example, if the actual precip. duration was 3 hours, you would enter -3 if fuels were still wet. If snow or ice still cover the sticks, but no precip. has fallen that day, enter -0. Any negative number sets all the indices to zero.

***-Note 6: For an amount less than .005 inches enter "T" (trace).

***-Note 7: Forecasted Man-Caused Risk is entered in OBS commands only. This value is then automatically used as the Man-Risk in any subsequent FCST display. This feature permits the Man-Risk to be entered at the Forest level (via OBS). It is combined with the Lightning-Risk calculated from the lightning forecast made by the weather service forecasters (via FCST or ZONE) to generate the total risk used to calculate the indexes.

***-Note 8: States of the weather 5, 6, or 7 (drizzle, rain, and snow), cause all indexes to be set to zero because generalized precipitation over the protection unit is assumed. States of weather 8 and 9 assume localized precipitation and will not zero out all indexes.

***-Note 9: ML is the lightning activity level which best describes the lightning situation from midnight to basic observation time. YL is the lightning activity lefel for the entire previous day. YL can't be less than the ML from yesterday's observations.

***-Note 10: The UNKO field consists of 0 to 8 letters or numbers in any format. (Do not use spaces, commas, semi colons or slashes). It may be used to send any type of miscellaneous information in special codes; e.g. cumulus cloud build-up state. The UNKO data is displayed without a heading on the DSPW OBS command. The data is not archived.

2.2.4 Examples of Use of OBS, SPC, ARCH Commands

Here are examples of OBS and SPC commands:

```
COMMAND?OBS 020202 13 1 95 25 1 37 NE 12 35 100 69 35 21 1 .01 1 44
COMMAND?SPC 020202 13 1 95 25 1 37 NE 12 35 100 69 35 21 1 .01 1
```

***-(Note that the SPC is identical to the OBS command if the predicted Man-Risk is removed. See Appendices J-2 and J-3 for sample forms.)

Here is a typical sequence showing the use of the ARCH command to archive data which was not entered the day the observations were made. First, the system date is set as necessary (See Section 1.4.6). Then, one or more ARCH commands follow. The Break-Key is hit after the series to revert the date back to today's. If a second set of ARCH commands follow the first, don't hit the Break-Key, but rather just enter another DATE command and continue with the next ARCH set.

***-Note: If the herbaceous vegetation condition has changed during the inactive period that the ARCH commands covers. The date must be reverted to today (use Break-Key) before a HERB or WOOD command can be given.

```
COMMAND?DATE 73/04/15     (First we set the date back as needed)

EXC04I DATE OVERRIDDEN 73/04/15

COMMAND?ARCH 020202 13 1 85 35 1 45 NW 7 23 90 68 52 25 1 .03 2
          (This archives the stale data for 020202-See Appendix J-3 for sample form)

COMMAND?ARCH 020601 13 1 84 37 1 52 N 6 26 89 67 45 31 0 0 1
          ( DATE command still in effect, archiving for 020601)

COMMAND?    (We now hit the Break-Key to revert the date)

EXC09I DATE REVERTED   (computer response)

COMMAND?HERB 020202 C 14     (Changing herbaceous vegetative condition for succeeding
                             ARCH or OBS commands.)

COMMAND?DATE 75/04/16        (Continue the archiving session)

COMMAND?ARCH 020202 13/4/48 90 1 25 NW 4 20 50 35 100 80 -5 .47 1
           (This archives weather data for April 16, 1975 including 14% herbaceous
           vegetative condition which was put in semi-permanent storage by the
           HERB command.)
```

For greatest efficiency, you should use a series of ARCH commands (for several days and/or stations) in one session, rather than singly. If several ARCH commands are entered for the same date and station, only the last entry will be permanently saved. This feature allows correction of errors made in archiving data.

***-Note: In Appendix J, Exhibits 1 and 2 are worksheets which can be reproduced and used to assist in the encoding of OBS, SPC, and ARCH commands. Exhibit 1 is for OBS commands and Exhibit 2 is for SPC and ARCH commands. The SPC and ARCH commands are identical to the OBS command if the last column - Man-Risk - is left off the OBS form.

2.3 Obtaining the Fire Weather Forecast Narrative

Predicted fire weather usually consists of both forecasted weather elements (temp., wind, etc.) and a narrative describing the expected weather. To obtain the narrative the FILE LIST FWX*nnn* command is used. The *nnn* represents the 3-letter airport abbreviation used by the National Weather Service. (See Section 1.2.7 for instructions on obtaining the 3-letter abbreviations from the USERLIST).

A sample command is:

```
COMMAND?FILE LIST FWXBOI
```

This command would give you the current forecast fire weather narrative issued by the Boise Office of the National Weather Service.

3. USING AFFIRMS-- THE FIRE WEATHER FORECASTER

3.1 ** ENTERING FIRE WEATHER FORECASTS **

AFFIRMS allows considerable flexibility to the forecaster as regards the entry of forecasted weather information. The FCST command is used to enter forecasts of the absolute values of meteorological variables for each station. The ZONE command allows a trend forecast to be applied to a group of stations within a fire weather forecast zone.

3.1.1 The Point Forecast-- The FCST Command

The weather data entered using the FCST command is used to compute predicted fire danger indices. Then the weather and the indices are both stored in a large random-access data file, called a Current Observation File (C.O.F.). This data file is accessible to all users. The new data replace any earlier data of the same type; that is, a new FCST would override the previous day's FCST. FCST entries are flagged as being forecasts. Data entered with FCST will be given the current date plus one day (that is, tomorrow's date).

OPERANDS FOR THE FCST COMMAND

Operand data	Type (see note 1)	Dec. Pt.	Min. Len.	Max. Len.	Min. Val.	Max. Val.	Missing-OK (see note 2)
Station #	Num.	No	6	6	010101	509999	Never
Valid Time	Num.	No	2	2	01	24	Never
State of Wx.	Num.	No	1	1	0	9	Never
Dry-blb.Temp.	Num.	Optional	1	4	-100	136	Never
Relative Humidity (see note 3)	Num.	Optional	1	3	1	100	Never
AL (Afternoon's Lgtg.Act.Lvl.)	Num.	No	1	1	1	5	Never
TL (Tomorrow's Lgtg.Act.Lvl.) (see note 4)	Num.	No	1	1	1	5	Never
Wind Direct. (see note 5)	Mixed	No	1	3	Varies	Varies	Anytime
Wind Speed	Num.	No	1	2	0	99	Never
10-HR-T/L Moisture (see note 6)	Num.	Optional	1	4	0	200	MODL/OPT Dep.
Max. Temp.	Num.	No	1	3	Dry-blb.	136	MODL/OPT Dep.
Min. Temp.	Num.	No	1	4	-100	Dry-blb.	MODL/OPT Dep.

OPERANDS FOR THE FCST COMMAND (continued)

Operand data	Type (see note 1)	Dec. Pt.	Min. Len.	Max. Len.	Min. Val.	Max. Val.	Missing-OK (see note 2)
Max. RH	Num.	No	1	3	Obs.RH	100	MODL/OPT Dep.
Min. RH	Num.	No	1	3	1	Obs.RH	MODL/OPT Dep.
Precip. Dur. 1 (see note 7)	Num.	No	1	2	0	16	Never
Precip. Dur. 2 (See note 7)	Num.	No	1	2	-8	7	Never

3.1.2 The Trend Forecast--The ZONE Command

The ZONE command is designed to simplify the work of the fire weather forecaster. When the forecaster normally issues trend forecasts for a fire-weather zone instead of specific values for individual stations, the ZONE command should be used instead of the FCST command.

When the forecaster enters a ZONE command, the trends are automatically applied to all current observations for stations located in that zone. Then, AFFIRMS generates forecast entries for each station, just as if the forecaster had entered a separate FCST command for those stations.

If one or more stations in the zone require a special forecast (that is, the trend doesn't apply to them), the FCST command can be used to override the ZONE forecast.

If experience shows that a station's fire weather zone should be changed, use the FWXZ command (Section 2.1.10). This command permits a change of zone number without the expense and effort of recataloging the station.

***-Note: If the current day's observation for a station is not entered into AFFIRMS before the ZONE forecast, there will be no forecast made for that station that day. If there are no current OBS for any station in a zone, the forecaster will receive a message with that information. A series of spot forecasts would then be needed for the missing stations. Since FCST commands contain absolute weather elements rather than trends, the computer can produce a forecast without current weather observations.

OPERANDS FOR THE ZONE COMMAND

Operand data	Type (see note 1)	Dec. Pt.	Min. Len.	Max. Len.	Min. Val.	Max. Val.	Missing-OK (see note 2)
Zone Number	Num.	No	3	3	001	999	Never
Region Number	Num.	No	1	2	1	10	Never
Valid Time	Num.	No	2	2	01	24	Never
State of WX (see note 10)	Num.	No	1	1	0	9	Never
Dry-blb. Temp. Trend	Num.	Optional	1	3	-30	+30	Anytime
Rel-Hum Trend (see note 3))	Num.	Optional	1	3	-50	+50	Anytime
Wind-Speed Trend	Num.	No	1	3	-30	+30	Anytime
Precip. Dur. 1 (see note 7)	Num.	No	1	2	0	16	Never
Precip. Dur. 2 (see note 7)	Num.	No	1	2	-8	7	Never
Max.-Temp. Trend (see note 8)	Num.	No	1	3	-30	+30	Anytime
Min.-Temp. Trend (see note 8)	Num.	No	1	3	-30	+30	Anytime
Max.-RH Trend (see note 8)	Num.	No	1	3	-50	+50	Anytime
Min.-RH Trend (see note 8)	Num.	No	1	3	-50	+50	Anytime
AL (Afternoon's Lgtg. Act.Lvl.,note 4)	Num.	No	1	1	1	5	Never
TL (Tomorrow's Lgtg. Act.Lvl.,note 4)	Num.	No	1	1	1	5	Never
10-HR-T/L Trend	Num.	Optional	1	5	-25.0	25.0	Anytime

3.1.3 Explanatory "Notes" for the FCST and ZONE Commands

***-Note 1: "Type" refers to the kind of character allowed; "Num." indicates numbers only; "Alpha." letters only; "Mixed", numeric or alphabetic.

***-Note 2: Under "Missing OK"; "Never" means the data are always required; "Anytime" means the data are not required but may be entered for the record (if it is not entered, an M must be typed in to fill that location). When an M is permissible and is used with the ZONE command, it will be treated as a zero trend (persistence).

***-Note 3: For FCST commands, the humidity variable is automatically assumed to be relative humidity, regardless of the HDEF in effect for the station.

***-Note 4: AL is the predicted lightning activity level (LAL) for this afternoon and evening from basic observation time to midnight. TL is the predicted LAL for tomorrow, midnight to midnight. The computer will use the highest of ML (See note 9, Section 2.2.3) AL, and TL to calculate Tomorrow's Lightning Risk.

***-Note 5: Wind direction may be entered in regular 8-pt. 1-digit form, in 16-pt. 2-digit form, in degrees of the compass 3-digit form, or in 16-point letter-codes. Thus, all of the following would give the same stored wind direction (the direction is stored internally as degrees-of-the-compass):

1, 02, 045, NE,

***-Note 6: Used if entered in FCST commands. If entered as missing, it is computed from the temperature and humidity forecast for basic observation time.

***-Note 7: "Fuels Wet" can be indicated by entering the Precip. Dur. as a negative number. For example, if the precip. duration was forecasted to be 3 hours, and fuels were expected to be wet at the forecast valid time, you would enter -3. Precip. Dur. 1 is for the first 16 hours; Precip. Dur. 2 for the last 8 hours for the 24-hour period between basic observations. If you expect the fuels to be covered by ice or snow which fell before this 24-hour period, predict a -0 (minus zero) for Precip. Dur. 2. All indices will be forced to 0 (zero) if a negative duration is forecast.

***-Note 8: If it is desirable to forecast the average 24-hour temperature and relative humidity, enter the same trend for both the Max. and Min. forecasted values. This will have the same effect as trending the averages.

***-Note 9: If the 10-HR-T/L Trend is entered as missing or is simply left out, the forecasted 10-HR moisture will be computed as shown in RM-84. If a trend is entered, it will be applied to the 10-HR T/L moisture value taken from the observation on which the forecast is based.

***-Note 10: States of weather 5, 6 or 7 (drizzle, rain, and snow) cause all indices to be set to 0 (zero).

3.1.4 Temporary Station Groupings--The STOW Command

There are times when fire weather forecasters wish to apply the same station forecast to more than one station, or the same zone forecast to more than one fire weather zone.

The STOW command permits this kind of blanket forecast to be made. The STOW command places up to 19 station-numbers or 19 fire-weather zone numbers into a <u>temporary</u> "stow" group within AFFIRMS. This "stow" exists only for the duration of that AFFIRMS session. The command takes two forms:

```
COMMAND?STOW ID,ℓℓℓℓℓℓ,mmmmmm,nnnnnn  (where ℓℓℓℓℓℓ, etc. are station identifiers)
COMMAND?STOW ZONE,ℓℓℓ,mmm,nnn  (where ℓℓℓ, etc. are fire weather zone identifiers
                                in the Forest Service Region)
```

The "stow" is held until another STOW overrides it.

The "stow" is then utilized by using the word STOW in place of either the zone-number (as in a ZONE command) or the station-number (as in a FCST command).

***-<u>Note</u>: The "stow" is eliminated at the end of the AFFIRMS session or whenever another STOW command (of the same type, ID or ZONE) is entered.

<u>3.1.5</u> <u>Examples of Use of FCST, ZONE and STOW Commands</u>

Here are examples of the FCST and ZONE forecasts:

```
COMMAND?FCST 020202,13,1,95,25,2,3,NE,12,M,100,71,36,21,1,4
```

(There is no forecast of the 10-HR T/L fuel moisture.)

```
COMMAND?ZONE 311,3,13,1,5,-2,0,1,5,3,-2,-2,1,1,-5
```

In the FCST example, the prediction relates to station 020202 only; in the ZONE example, the trends will be automatically applied to the current observations of all the stations in forecast zone 311 in F.S. Region 3.

***-<u>Note</u>: In Appendix J, Exhibits 3 and 4 are worksheets which can be reproduced and used to assist in the encoding of FCST and ZONE commands.

Here now is an example of using the STOW command. First, tell the computer which stations (forecast zones) that the FCST STOW (ZONE STOW) is to be applied to, and then enter the appropriate STOW command.

```
COMMAND?STOW ID,020202,020203,020204

COMMAND?FCST STOW,13,1,95,25,2,3,NE,12,M,100,71,36,21,1,3
```

The identical FCST command will be applied to stations 020202, 020203, and 020204.

```
COMMAND?STOW ZONE,301,302,303
COMMAND?ZONE STOW,3,13,1,+5,-2,+2,0,1,+5,+4,-2,1,1,-5
```

The identical trends specified in the ZONE command will be applied to all stations in fire weather zones 301, 302, 303, in Forest Service Region 3.

***-Note: The F.S. Region number is the first operand after ZONE STOW verb. Before a ZONE STOW... command can be used, a STOW ZONE command must precede it sometime during the session. Likewise, a FCST STOW... command must be preceded sometime during the session by a STOW ID... command. Failure to do this will result in an error message and a request for a new command.

3.1.6 The Forecast Narrative

It is customary for narrative descriptions of synoptic patterns, trends, outlooks, etc. to be part of the fire weather forecast. AFFIRMS allows such information to be communicated to the fire manager through a text file (see the FILE MAKE command, Section 1.7.1). It is only necessary for the fire manager to know the name of the text file that contains the narrative. He can retrieve the narrative with the FILE LIST command.

File names for these narratives are designated as follows:

FWXwww

where the www is the alphabetic identifier of the Weather Service Forecast office. For instance, FWXLAX represents Los Angeles. The alphabetic identifiers for all airports entering data into AFFIRMS are in the USERLIST. Section 1.2.7 explains how to obtain the USERLIST.

If several narratives are routinely issued from one forecast office, they might be designated by appending a number. For instance: FWXLAX1, FWXLAX2, and FWXLAX3.

An example of a forecast narrative can be found in Appendix A.

3.2 ** AMENDING THE FIRE WEATHER FORECAST **

If a forecast, whether issued as a FCST or ZONE command requires amending the same day as the original forecast, no special procedures are required. Simply enter the amended forecast the same way as you would enter the original.

However, if the forecast requires amending the next day (the day the original forecast was valid for), the DATE command must be used first (see Section 1.4.6). It is necessary because the date assigned to the forecast by the computer is the current date plus 1 (Section 3.1.1). If you attempt to enter a ZONE command without resetting the date, you will get an error message because there will be no observations found in the C.O.F. with today's date. If you use the FCST command, the valid date would be tomorrow's (today's date plus 1).

Example of amending a forecast on June 28 which was originally issued on June 27:

```
COMMAND?DATE 74/06/27

EXC041 DATE OVERRIDDEN 74/06/27

COMMAND?ZONE 311,3,13,2,7,1,4,2,1,4,4

COMMAND?  (Operator hits Break-Key to revert date)to June 28)

EXC091 DATE REVERTED   (Computer response)

COMMAND?     (continue business).
```

4. USING AFFIRMS -- THE REGIONAL FIRE MANAGER

4.1 ** SCREENING LARGE STATION GROUPS **

To permit managers with large numbers of stations to selectively display a few stations, the screening SET commands were introduced.

4.1.1 Screening by Manning Class -- The SET MC Command

In the following example a user wished to sort through all 170 California stations and only see these stations that were in manning plans 4+ and 5:

```
COMMAND?SET MC 4+

COMMAND?DSPX OBS STAT 04
```

The following values are possible MC minimums:

```
0  1-  1+  2-  2+  3-  3+  4-  4+  5
```

4.1.2 Screening by Adjective Class -- The SET AC Command

In the following example the manager would see only those stations in Very High or Extreme Adjective Class:

```
COMMAND?SET AC VH
COMMAND?DSPX OBS STAT 04
```

The following values are acceptable AC minimums:

```
0  LO  MD  HI  VH  EX
```

4.1.3 Double Screening

As was pointed out in Section 1.4.9, all SET commands can be mixed on one line. In this example, the user has said "show me only those stations with MC equal to, or above 4+, AC of EX, and produce these displays with station names."

```
COMMAND?SET MC 4+,AC EX,NAME ON
```

***-Note: To return the SET command above to the "normal" state, either sign off or:

```
COMMAND?SET MC 0,AC 0,NAME OFF
```

4.2 ** MONITORING REGIONAL OBSERVATIONAL ACTIVITY **

Each night at 2300 MST the archiver program searches the current observation file and copies that day's OBS records into permanent storage. This copy process produces an accounting file indicating how many new records originated in each Forest Service Region. This example shows how this accounting file may be listed:

```
COMMAND?FILE LIST ARCHSTAT

ARC01I  START  10/22/74  AT  23:01MDT
ARC03I  REG.   1,    0 RECS.
ARC03I  REG.   2,   20 RECS.
ARC03I  REG.   3,   18 RECS.
ARC03I  REG.   4,   43 RECS.
ARC03I  REG.   5,  168 RECS.
ARC03I  REG.   8,    0 RECS.
ARC03I  REG.   9,   11 RECS.
ARC03I  REG.  10,    0 RECS.
ARC02I     3 RECORDS COPIED FROM MODS
ARC08I  STOP  10/22/74  AT  23:04MDT  ( 56.5 CRU)
```

The line referring to records copied from MODS reports on the total numbers of observations entered with the DATE-ARCH command combination.

Please inform the AFFIRMS staff of large changes of use such as many stations coming on the system in the spring and terminating use in the fall.

4.3 ** LINKING TO ANCILLARY ROUTINES **

Several Ancillary Routines have been provided to organize and display the data base supporting the AFFIRMS system. The objective is to provide the Regional or State level manager the ability to get an overview of what is being done in his area. These routines can be accessed via the LINK command.

4.3.1 Summarized Station Catalogs for Regional Areas -- The LINK CATLDUMP Command

The routine produces a list of all the stations cataloged within a particular Region. The total station catalog is condensed into one line containing station number, elevation, time zone, Forest or unit abbreviation, operating agency code, basic observations time, Fire Weather Zone, station name, and the AFFIRMS user number of the owner.

Example:

```
COMMAND?LINK CATLDUMP

**AFFIRMS ANCILLARY ROUTINES: CATALOG DUMP

DO YOU WANT ALL REGIONS (YES/NO)?NO    (You type in Yes or No)

WHICH REGION NUMBERS?9                 (You supply the region number)

STATIONS STASHED IN CATALOG REGION 9:

STATION   ELEV   ZONE  FOR. REG.  AG.   TIME  FWX   NAME      USER
202902    1050   EST   HMNF   9    1     14   945   MIO       904
203802     832   EST   HMNF   9    1     14   944   BALD      904
236401    1200   CST   NFIM   9    1     13   976   SALEM     905
238601    1281   CST   NFIM   9    1     13   978   AVA       905
239101     467   CST   NFIM   9    1     13   977   DONAHN    905
270301     461   EST   WHMT   9    1     13    10   CONWAY    922
430802    1395   EST   GMNF   9    1     13   780   BRDLOF    920
431101     670   EST   GMNF   9    1     13   782   TABOR     920
431202     880   EST   GMNF   9    1     13   780   ROCH      920
464203    2200   EST   MONO   9    1     13   924   MARLIN    921
470205    1600   CST   CHEQ   9    1     14   964   INO       902
470802    1600   CST   CHEQ   9    1     14   963   CLMLKE    902
471101    1580   CST   NICL   9    1     13   960   LAONA     906
471201    1560   CST   NICL   9    1     13   960   LONGLK    906
472001    1300   CST   NICL   9    1     13   955   LAKEWD    906

TOTAL OF   15 STATIONS IN REGION
------------------------------------------

COMMAND?
```

4.3.2 Listing S.I.G. Contents -- the LINK SIGDUMP Command

This routine displays an accounting of all the S.I.G.'s giving the S.I.G. number, the owner, date of last modification, and the station numbers that the owner inspects on a regular basis. The example has been cut short to save space, but had it run to completion, it would have returned with the prompter "COMMAND?".

```
COMMAND?LINK SIGDUMP


**AFFIRMS ANCILLARY ROUTINES: SPECIAL-INTEREST GROUP DUMP
WANT STATION NUMBERS (YES/NO)?YES


CURRENTLY ASSIGNED S.I.G.'S
AS OF     15:46GMT   12/24/74

NUM.  OWNER   LAST-MOD     STATIONS

001    304      7/74        20209    20203
002    304      7/74        20202    20207    20210
003    310      7/74        20501    20502   292001   292005
004    305      7/74        21201    21202    21301    21403
005    501      7/73        45326    45318    45328    45323    45301
                            45325    45305    45313    45321    45324
                            45311    45307    45316    45306
006    508      8/73        41406    41005    41101    41503    41402
```

***-Note: The objective in producing this listing is to help call attention to inefficient operations. The S.I.G. proves to be more expensive than any other display scope (see 1.5.4) except the FOR and UNIT until the group contains 5 or more stations. On that criterion, S.I.G.'s 001 through 004 should be emptied and a LIST command used instead.

4.4 ** COMPUTER PORT ACCESS CHANGES **

G.E. computer access numbers are occasionally changed and new numbers made available. For this reason, G.E. has provided a "Free" user number that announces changes in the existing network of computer ports. These changes are noted against a basic list of telephone numbers called the International Access Directory. This publication is available from the local G.E. business office on the assurance that your office is a TIMESHARE customer.

The following example illustrates this service:

```
HH
U#VHA03000     (free GE User Number)

THIS PROGRAM PROVIDES UPDATES TO THE  G.E. INT'L ACCESS DIRECTORY:

DATA ON FILE:   CHANGES FROM 10/01/74 THRU 12/13/74

OPTION 1:  ALL CHANGES ON FILE
OPTION 2:  ALL CHANGES SINCE A SPECIFIED DATE.
OPTION 3:  ALL CHANGES FOR A SPECIFIED STATE/PROVINCE/COUNTRY.

OPTION?3          (You specify option)

NAME OF STATE/PROVINCE/COUNTRY ?CALIFORNIA       (You specify state)
--------------------------------------------------------------------------------

            G.E. INTERNATIONAL ACCESS DIRECTORY UPDATES
            REFERENCE     WHITE    BOOK  : PUBLISHED OCT. 1974
               CHANGES FROM 10/01/74 THRU 12/13/74

                 ACCESS TEL #      CUST SERVICE    DATE      CHANGE
                --------------   --------------  --------  ----------
CALIFORNIA

    BORON      (714) 726-6131    (800) 638-2960  10/02/74   DISCONNECT
    BORON      (714) 762-6131    (800) 638-2960  10/02/74   NEW NUMBER



* - INDICATES 15 CHAR/SEC SERVICE OR LESS.


                              PAGE  1

--------------------------------------------------------------------------------
```

APPENDICES

```
FIRE WEATHER FORECAST...FRESNO,CALIF...MAY 7,1974...1500PDT

DISCUSSION...REMNANTS OF WEAK COLD FRONT MOVING THRU CENTRAL CALIFORNIA HAS PRODUCED
SOME HIGH CLOUDINESS BUT NO PRECIPITATION IS OCCURRING.  HIGH PRESSURE BOTH AT THE
SURFACE AND ALOFT IS DEVELOPING ALONG WEST COAST INDICATING CLEARING AND WARMING
STARTING TONIGHT.  NEXT STORM SYSTEM NOW IN GULF OF ALASKA WILL BE BLOCKED FROM
MOVING INTO CENTRAL CALIFORNIA.

TONIGHT...CLEARING MOST AREAS WITH PATCHES OF FOG FORMING BY MORNING ALONG COASTAL AND
INLAND VALLEYS.  CONTINUED COOL TEMPS.

FRIDAY...MOSTLY FAIR WITH FOG DISSIPATING DURING EARLY MORNING.  SLIGHTLY WARMER AND
DRIER ALL AREAS.

OUTLOOK...UPPER RIDGE BUILDING OVER STATE FOR FURTHER WARMING AND DRYING.  SURFACE
HIGH MOVING OVER PLATEAU TO CREATE OFFSHORE GRADIENT AND LESS CHANCE OF FOG AND LOW
CLOUDS ALONG COAST.

AVERAGE TRENDS...ALL AREAS...TEMPS UP 4, HUMIDITY DOWN 4% F.M. DOWN 2%, WINDS ABOUT
THE SAME WITH OCCASIONAL GUSTY N-NE

COMMAND?SET NAME ON       (This causes names to be displayed rather than station numbers)
COMMAND?DSPI FCST,ZONE 506,5  (Fire manager requests a display of the forecasted indexes
                               for Zone 506, R-5)


-------------------05/06/74-------FCST---------22:18 GMT------------------
STA-NO MS DY HR DBT  RH WS LR MR HB V FF  10 100 IC SC EC OI BI FLI MC  AC
--------------------------------------------------------------------------

TOP    B3  7 14  61  67  5  0 11  0 7 10  15  13 25  5 35  3 18  19 2   M
HLSIDE B3  7 14  60  45  7  0 21  4 5  7  10  12 40 11 50  9 29  32 3+  M
SPRING B3  7 14  65  57  4  0 24  3 7 11   9  13 19  5 43  5 19  20 3-  M
BEAR   A1  7 14  56  48  7 25 35 10 0 12  41  13 14  3  6  9  2   2 2+  L }
                                                                          }(multiple fuel
BEAR   B2  7 14  56  48  7 25 35 13 5 12  41  13 14  6  7  9 10  11 2+  L }    models)
WILLOW B3  7 14  65  49  4  0 49  5 5  9   9  15 30  7 45 15 22  25 3-  M
```

```
COMMAND?DSPW FCST,ZONE,506,5     (Fire manager requests a display of the forecasted
                                  weather for Zone 506, R-5)

-----------------05/06/74-----FCST------22:20 GMT------------
STA-NO DY HR W DBT DPT  RH AL TL DIR WS TMX TMN HMX HMN P1 P2
-------------------------------------------------------------

TOP     7  4 0  61  50  67  1  1      5  70  46 100  49  0  0

HLSIDE  7  4 0  60  39  45  1  1      7  69  33 100  33  0  0

SPRING  7  4 2  65  49  57  1  1      4  73  48 100  43  0  0

BEAR    7  4 2  56  37  49  1  1      7  60  49  51  42  0  0

WILLOW  7  4 1  65  45  49  1  1      4  65  40 100  49  0  0


COMMAND?SET DAYS -1


COMMAND?DSPU FCST 5,044712B3 25,045102B3 10,045207B3 30,&

OK MORE?045296B2 20,045305B3 15    (Fire manager requests a weighted fire danger rating
                                    for 5 stations)


 ----05/06/74------FCST-------22:20GMT---
       DY         IC         MC         AC
 ----------------------------------------

        7         20         3-         M

 COMMAND?BYE

 SESSION COST: $  3.34

 OFF AT 16:22PDT 05/06/74
```

APPENDIX B.

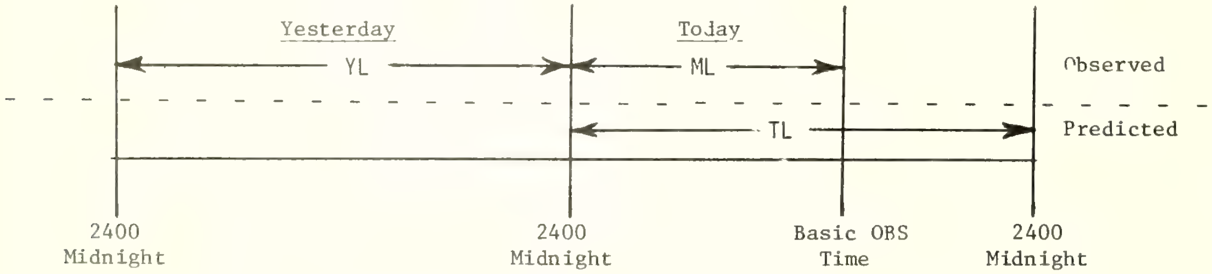
How AFFIRMS Determines Lightning Risk

As explained in RM-84, lightning risk (LR) is meant to account for fires set by lightning on the preceding day (holdovers) as well as fires set during the day being rated. In order to do this, a lightning activity level (LAL) for both days is needed.

Today's Lightning Risk

Let us first look at the problem of determining the LR for "today". First of all, we need a LAL which represents yesterday's lightning occurrence. Next, we need a LAL to represent today's lightning situation. What information do we have to work with? The observer has reported a LAL in Col 37 of the D-9a for yesterday; so that takes care of the first LAL. For today, the computer has a choice; it can either use the LAL reported by the observer for the period midnight to basic observation time (Col 11, D-9a), or it can use the LAL predicted by the fire weather forecaster for all of today. The computer will choose the higher of the two to use with yesterday's LAL to calculate today's LR.

Let's show this diagrammatically.



Where:

"YL" is the observed LAL for yesterday (Col 37, D-9a)

"ML" is the observed LAL today since midnight (Col 11, D-9a)

"TL" is the LAL predicted for all of today.

EXAMPLE

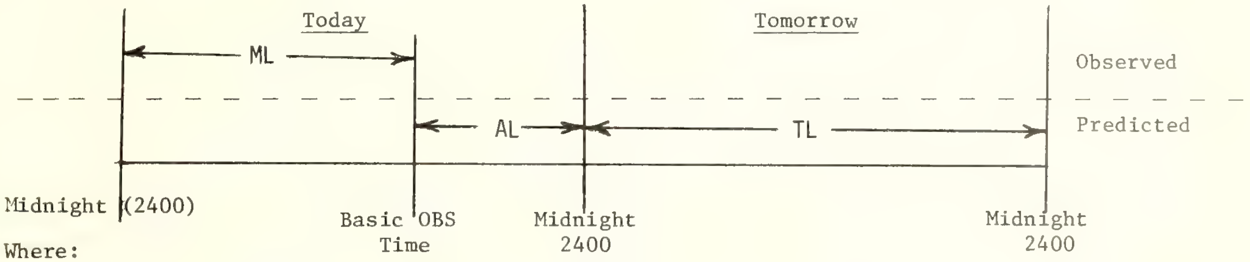
The observer reports yesterday's LAL (YL) as a 4 and this morning's LAL (ML) as a 2. The fire weather forecaster predicted a LAL (TL) of 4 for today. Since the TL is greater than ML, the computer will use 4 for today's LAL. Hence, the computer calculates today's LR as 50.

You can get the same answer by going to Table E-1, RM-84 (p. 23). At the intersection of the row indexed by YL (4) and the column indexed by TL (4), is the LR value 50.

Tomorrow's Lightning Risk

To derive "tomorrow's" LR, LAL's for today and tomorrow are needed. For today's LAL the computer must choose between the LAL reported by the observer for the period midnight to basic observation time (Col 11, D-9a) and the LAL predicted on today's fire weather forecast for the period from basic observation today to midnight. The computer will choose the higher of the two for today's LAL. Tomorrow's LAL is predicted on the same forecast.

Let's diagram the situation.



Where:

"ML" is the LAL observed today since midnight. (Col 11, D-9a)

"AL" is the LAL predicted for the remainder of today (basic observation time to midnight) on today's forecast.

"TL" is the LAL predicted for tomorrow.

EXAMPLE

The observer reports this morning's LAL (ML) as a 2. Today's fire weather forecast predicts a LAL of 5 for the remainder of the day (AL) and a LAL of 2 for tomorrow (TL). Since AL is greater than ML, the computer will choose 5 for today's LAL. Using a 5 for today and a 2 for tomorrow the computer calculates tomorrow's predicted LR as 30.

Looking again at Table E-1, you will find a LR value of 30 at the intersection of the row indexed by AL (5) and the column indexed by TL (2).

APPENDIX C

How AFFIRMS Determines the Displayed Manning Class (MC)

The National Fire Danger Rating System provides six ratings for the use of the fire manager. Any one of the six may be used as the basis for determining the manning class or readiness level of the suppression organization. The OPT command permits you to specify which of those six components or indices are to be used as the Manning Index (MI). (See Section 2.1.3)

For the Forest Service at the time of this writing, the 90th and 97th percentile Burning Index values for each station's fuel models are used to determine manning classes.* These percentile values are determined from a statistical analysis of historical fire weather observations. These values provide the criteria for ranking the relative severity of the burning conditions on a given day.

The MI90 and MI97 values are employed by AFFIRMS to generate a table of test values against which the Manning Index for each model can be compared. There are always 10 such test values, corresponding to a nine-class system (nine classes plus zero).

However, the actual number of manning classes in use by a given administrative unit may be five, seven, nine or even three. For this reason, AFFIRMS always computes manning class based on a nine-class system, but what is displayed as manning class depends on a selection made when the MODL command for that station was entered. This operand, referred to in the User's Guide as "Number-of-Display-Classes" (Section 2.1.4), is used to specify whether displays for that station will show nine classes, three classes, etc.

The break-points used to determine the manning class in the nine-class system are as follows:

Computed Class Level	Upper Value for Class
0	MI=0
1	(MI90)/8
2	(MI90)/4
3	(MI90)(3/8)
4	(MI90)/2
5	(MI90)(3/4)
6	MI90
7	(MI90 + MI97)/2
8	MI97
9	More than MI97

---

* The Bureau of Land Management is using the 80th and 95th percentiles of the BI.

The table that follows shows which of the nine-class manning class designators will appear for any number of selected manning classes. To use the table, use the row which shows the number of manning classes which your administrative unit employs. Across the row will be the displayed manning classes for each corresponding nine-class value.

Computed 9-Class Level	0	1	2	3	4	5	6	7	8	9
Desired # of Manning Classes	Displayed Manning Class									
3	0	1	1	1	1	1	1	4	4	5
4	0	1	1	1	1	3	3	4	4	5
5	0	1	1	2	2	3	3	4	4	5
6	0	1	1	2	2	3-	3+	4	4	5
7	0	1	1	2	2	3-	3+	4-	4+	5
8	0	1	1	2-	2+	3-	3+	4-	4+	5
9	0	1-	1+	2-	2+	3-	3+	4-	4+	5

APPENDIX D

How AFFIRMS Determines the Displayed Adjective Class (AC)

In March 1974 at a meeting of Forest Service, BLM, and State Forestry representatives a means of specifying the level of fire danger for public information was fabricated. It was agreed that the system would be tried during the 1974 and 1975 seasons. For that reason, the AC has been incorporated in AFFIRMS. Most organizations are using the adjective class only for public information. Manning Class (Appendix C) is used for "in-house" fire preparedness information. Note that MC-3 can have an AC of Moderate, High or Very High.

The adjective class is expressed in the traditional manner as one of five levels; Low(LO), Moderate(MD), High(HI), Very High(VH), and Extreme(EX). It is derived from a combination of Manning Class and Ignition Component as follows:

Ignition Component	0-20	21-45	46-65	66-80	81-100
Manning Class(MC)	Adjective Class				
0[1]	0	0	0	0	0
1-,1,1+	LO	LO	LO	MD	MD
2-,2,2+	LO	MD	MD	MD	HI
3-,3,3+	MD	MD	HI	HI	VH
4-,4,4+	MD	HI	VH	VH	EX
5	HI	VH	VH	EX	EX

[1] The "zero" is included for those cases where AFFIRMS is not determining the station MC.

APPENDIX E

How AFFIRMS Weights the Inputs to the DSPU Command

The DSPU command combines data from up to 9 fire weather stations and produces an integrated fire danger rating. The manager must select the stations to represent the area and determine the influence that each station is to have on the weighted area fire danger--that is, the station weighting factor. The only requirement of AFFIRMS is that the weighting factors of the stations within the area add up to 100 percent.

The station weighting factor is based on the manager's local experience considering such things as: percent of the total area represented by this station; resource values; historic fire occurrence; public use patterns; and other. For a complete discussion of weighting factor selection see:

(Reference: 1972. Deeming, John E. Fire Danger and Fire Weather Seminar, Interpretation and Application, p. 3).

In the case of a missing station, its weighting factor will be distributed proportionally to the reporting stations. Consider a unit with three stations as follows:

Station	Weighting Factor (w)
A	22
B	44
C	34
	100

If Station C fails to report, the weighting factors will be reset as follows:

Station	Weighting Factor (w)
A	$100 \frac{22}{22 + 44} = 33$
B	$100 \frac{44}{22 + 44} = 67$
	100

The Weighted IC

Using the above example, a weighted average IC for the Stations A, B, and C would be obtained as follows:

Station	Weighting Factor(w)	IC(i)	(w)(i)÷100		AVG IC
A	22	38	8.36		
B	44	47	20.68		
C	34	58	19.72		
	100		48.76	round	49

The Weighted Manning Class

The manning classes must first be determined for each station using the nine-class system. (see Appendix C). Each is then assigned a factor according to the following schedule:

Manning Class	x	Class Factor (m)*
0	0	0
1-	1.25	1.19
1+	1.75	1.68
2-	2.25	2.37
2+	2.75	3.36
3-	3.25	4.76
3+	3.75	6.73
4-	4.25	9.51
4+	4.75	13.45
5	5.25	19.03

*$\ln m = x \ln 2 - \ln 2$ where x = 1.25, 1.75, 2.25, 2.75, 3.25, 3.75, 4.25, 4.75, and 5.25

The weighted manning class would be determined as follows:

Station	Wt. Factor(w)	Man. Cl.	Class Factor (m)	(m)(w)÷100
A	22	2-	2.37	.52
B	44	3+	6.73	2.96
C	34	4-	9.51	3.23
	100			Σ= 6.71

The 6.71 is translated to a weighted manning class by use of the following table:

Weighted Manning Class	Σ[(m)(w)÷100]
0	0- 0.99
1-	1.00- 1.40
1+	1.41- 1.99
2-	2.00- 2.82
2+	2.83- 3.99
3-	4.00- 5.65
3+	5.66- 7.99 ←←←
4-	8.00-11.30
4+	11.31-15.99
5	16.00

In the example Σ [(m) (w)÷100] = 6.71. Therefore, the weighted manning class is 3+ or a High 3.

The Unit Adjective Rating (AC)

The unit adjective rating would be derived similarly to the station AC (Appendix D) except that the unit weighted IC and MC would be used.

Wt. IC	Wt. MC	Unit AC
49	3+	HI

APPENDIX F

Use of AFFIRMS in Prescribed Burning Operations

AFFIRMS is designed primarily for the day-to-day processing of fire-weather observations, but the system can also be used for prescribed fires by setting up 'pseudo-stations' and processing the weather observations the same as for regular fire weather stations.

By convention, AFFIRMS considers any station number whose last two digits are between 90 and 99 as a 'pseudo-station'. Data entered for such a station are understood to be for field operational use, training, or for research; the observations are not archived. This permits you to assign a station number, enter observations for that station, and display indexes. Yet the data will not go into the permanent records.

Several days before your prescribed burn, you would enter the proper cataloging commands for your pseudo-station (see Section 2.1). When the catalog is completed, entry of the special observations can begin. Typically, personnel will visit the burn site and install a set of 10-hr fuel moisture sticks, a hygrothermograph and a rain gauge. They will then return periodically to take weather measurements and weigh the sticks. In a few days the drying trend and daily fire danger fluctuations can be examined by running the observations through AFFIRMS using standard procedures.

You should coordinate with your local fire weather forecaster during the period observations are being taken. He can obtain prescribed burn weather readings the same as routine weather observations.

If multiple weather readings are made each day in preparation for a prescribed burn (e.g. 0900, 1300, and 1800), special procedures are needed. The recommended method is to enter 1300 readings as regular OBS commands at the same time routine weather is entered. SPC commands should be used to enter additional readings and DSPX SPC commands used to display computed indexes. Three points should be remembered when using SPC commands: a) it is cheaper to enter data only once daily; b) only one SPC observation is stored per station. DSPX SPC commands must be made before an additional SPC observation is entered for that station. If you want to send two or more SPC observations for each station to the fire weather forecaster, you must construct a special file (see Section 1.7) which the weather forecaster can execute with a FILE READ command; c) SPC commands cause no change in fuel moisture contents of heavier fuels (100-hr T/L fuels). The OBS command is necessary once daily to correctly compute the 100-hr timelag fuel moisture.

APPENDIX G

The Format of AFFIRMS Archived Fire Weather Data

Punch Card Format (Modified) for WS Form D-9a

Field Description	Begin Col.#	End Col.#
Station Number	1	6
Year	7	8
Month	9	10
Day	11	12
State of Weather		13
Dry-Bulb Temp.	14	16
Relative Humidity	17	19
* 1-Hr-T/L Moist.	20	22
Herb-Veg-Cond (Model 1)	23	24
Man-Caused-Risk	25	27
Wind Direction (8 point)		28
Wind Speed	29	31
Woody-Veg-Cond (Model 1)		32
* 10-Hr-T/L Moist.	33	35
* 100-Hr-T/L Moist.	36	38
Max. Temp	39	41
Min. Temp.	42	44
Max. R.H.	45	47
Min. R. H.	48	50
Not Used		51
Precip. Duration	52	53
Precip. Amount	54	57
Lightning Act. Level	58	60
Digit "2"		61
Model 1 I.D.		62
Secondary Models:		
Model 2 I.D.		63
Model 2 Woody		64
Model 2 Herb	65	66
Model 3 I.D.		67
Model 3 Woody		68

Model 3 Herb	69	70
Model 4 I.D.		71
Model 4 Woody		72
Model 4 Herb	73	74
Model 5 I.D.		75
Model 5 Woody		76
Model 5 Herb	77	78
* Forecast Flag		79
Region Number		80

* See paragraph 6

** 1=Forecast, A or blank=OBS

Explanatory Notes for Modified WS D-9A Card Format

The card images in the format described on the preceding page are generated by the archiving processor of the "AFFIRMS" program.

Some variations from the normal Weather Service WS D-9a form have been introduced. They are described below:

1) Because all humidity entries are converted by "AFFIRMS" to relative humidity (even though the input may have been wet-bulb, dewpoint, or R.H.) only the relative humidity is available for archiving. The presence of the digit "2" in card column 61 indicates that the data in columns 17-19 is relative humidity and not wet-bulb (which is standard for the WS-D9a).

2) The "AFFIRMS" system permits up to 5 fuel models to be associated with any given station. A separate woody-vegetation-condition and herbaceous-vegetation-condition can be specified for each model. Because later use of this data may require these conditions (for example, if live-fuels are involved), the card format has been modified to include the first model's values in the normal positions on the card (23-25 for herbaceous, 23 for woody condition. The model identifier (a letter from A through I) for the first model is then placed in column 62. The other four models have their identification herbaceous-condition, and woody-condition placed in columns 63 through 78. Subsequent processing of these card images should check for a blank Model I.D. in column 62 indicating no model specification.

3) In the Max/Min temperature and humidity fields, a value of 100 in both Max and Min indicates that both values were missing. Subsequent processing should make this check.

4) The Forest Service Region number (columns 79-80) is included for convenience in sorting by the National Fire Danger Rating Library before distribution to regional ADP offices.

5) The wind direction 8-point code in the card images has been derived from the sorted degrees-of-the-compass value. Some stations may enter wind direction in systems other than 8 point which offer more resolution, such as 16 point or degrees-of-the-comapss. Such additional resolution is, of course, lost when this conversion to 8 point is made. Missing direction is recorded in the card images as "0".

6) The 1-, 10-, and 100-hour timelag fuel moistures are only archived if actually entered (non-missing) in an observation. In all cases where these items are computed from ambient conditions, they appear in the archived records as zero or blank.

7) For the period 1973 through March 1975 "AFFIRMS" made only one consistency check on the precip. amount: values were required to be between 0 and 10.00 inches. Occasionally, field personnel would enter 9 when they should have entered .90 or .09. These three values are all valid as far as the AFFIRMS program is concerned, therefore large precipitation amounts should be viewed with suspicion for this period.

APPENDIX H

Common Errors

		Reference
1.	The exact format must be used in the sign-on procedure. This requires the identification number, comma, password, comma, operators name or initials, carriage return. Spaces are not permitted.	1.4.1
2.	Use the proper error correction method. The back space procedure (commonly a back arrow) to enter corrected data; the "control X" to delete an entire line; and the "break" key to stop the printing and execution of an unwanted operation.	1.3.2 1.4.4
3.	Station catalogs should not be deleted at the end of each fire season. It is cheaper to leave the stations cataloged in the computer. The cost of storing the catalog is very small and is included as part of the AFFIRMS overhead charges.	2.1.8
4.	Error messages should be read and the expanded explanation looked up in Appendix I. Remember, the letter at the end of the message number will tell you if the message is for information (I) and the command has been accepted; for action (A) and the command rejected; or for referral (R) to the AFFIRMS staff for corrective action.	Appendix I
5.	A space is not permitted between the prompter (command?) and your command.	1.2
6.	If an entire entry has been left out of an OBS command, the error message up arrow (↑) may not show the exact location of the error. (For example, if the wet bulb temperature has been left out, the error message might be that a letter entry (for wind direction) was found in a field reserved for numerals and the arrow indicates the man-caused risk field.)	2.2.1
7.	When entering observations, a minus sign should be entered with the precipitation duration to show that fuels were wet or covered with snow or ice at observation time -- this causes all indexes to go to zero.	2.2.1
8.	When entering observations, use a "T" for a trace of rain (less than .005 inches).	2.2.1

		Reference
9.	The FOR or UNIT designations on the display command cost about three times as much as LIST or ID designations that list the stations. The SIG command is inefficient for less than four stations.	1.5.1
10.	Use SET DAYS -1 command before making DSPU FCST commands for tomorrows forecasted weather. The SET DAYS -1 command is not used if you are making a DSPU FCST command in the morning to cover the rest of the same day.	1.5
11.	The "Break" Key terminates the FILE MAKE operation. Be sure to use a carriage return to enter the last line of text into the file before the "Break" Key is depressed.	1.7.1
12.	Use a FILE LIST command to view the contents of a file. The FILE LIST is used for fire weather narratives, etc. The FILE READ command tells the computer to execute the commands in the file in the same order they are entered.	1.7
13.	The name of a file cannot contain a space.	1.7.6
14.	Storage costs for most files are $1.10 per month per file. Purge old files when no longer needed.	1.7.6
15.	Check to be sure a POST command has been completed before purging the file.	1.8.3
16.	Be very careful in using FILE READ commands within files. A loop may result where File A instructs the computer to read File B which tells the machine to read File A. Computer costs which you pay can mount very quickly from this error. Use the "Break" Key to stop an undesired action, and a FILE LIST to view the contents of a file to determine source of errors.	1.7.3
17.	A MODL command erases the herbaceous and woody vegetative conditions. New HERB and WOOD, (for Models B and F), commands must follow a MODL command.	2.1.4, 2.1.5 2.1.6

APPENDIX I

Explanation of AFFIRMS Messages

All AFFIRMS messages consist of two parts : a brief message, preceded by a code--three letters, two digits, and a suffix letter. The suffix letter indicates the kind of message:

A	ACTION--The indicated error must be corrected by the terminal operator.
I	INFORMATION--Probably nothing wrong.
R	SERIOUS PROBLEM--Report to system staff immediately !

The following telephone numbers may be used to report SERIOUS PROBLEMS (R) with AFFIRMS. Please use the numbers in the order given:

Regular Hours	Commercial	208-336-2200, Ext. 287
Regular Hours	FTS	208-588-9287
Regular Hours	Commercial or FTS	714-787-1572
After Hours	Commercial	714-686-1968
To leave a recorded message if no answer at other numbers	Commercial	714-686-4656

* * * *

ALF01A NON-ALPHABETIC CHARACTER IN ALPHA OPERAND

A character other than A thru Z or - was found in an operand which AFFIRMS expects to be alphabetic. The up-arrow points to the defective operand.

ALF02A IMPROPER LENGTH

AFFIRMS has found more than 4 characters in an operand which was expected to be alphabetic (or mixed).

CFP02R OBS-FILE'S DIRECTORY FULL, ENTRY NOT STORED

The current observation file was found to be full. Report immediately to AFFIRMS staff since the file for the Region must be expanded or no new data can be recorded.

CTL01R CAT-DIRECTORY I/L FAILURE

The catalog-directory indicates that a given station is cataloged, but the corresponding record in the catalog does not refer to that station. Report to AFFIRMS staff for corrective action.

CTL02A INVALID STATION NUMBER

In a catalog-maintenance command, the station-number given is not 6 digits long.

CTL03A STATION NOT IN CATALOG

A request to delete, describe, or modify a catalog entry was enterd for a station not previously cataloged, or one that has already been deleted.

CTL04A IMPROPER LENGTH

An operand has the wrong number of digits or letters. Refer to manual sections on CTLG, HDEF, OPT, MODL, HERB, NAME, or WOOD commands, as appropriate.

CTL05A INVALID TIME-ZONE

Time-zone must be entered as EST, CST, MST, or PST only in the Continental U.S. HST can be used for Hawaii and most of Alaska. Use BST for far western Alaska, and YST for the small part of eastern Alaska not in Hawaiian time.

CTL06A INVALID STANDARD OBS-TIME

Standard-Observation-Time must be entered as a 2-digit number between 01 and 24.

CTL07A INVALID OPTION-CODE

Option-code must be entered as a 1-digit number, 1 through 5 only.

CTL08A MODEL OPERANDS NOT IN "TRIPLES"

Following the STATION-I.D. and DISPLAY-CLASS-NUMBER in the MODL command, the operands must be entered in sets of three (MODEL-NAME,SLOPE-CLASS,MI97-MI90), one set for each model to be specified. Up to five sets are permitted.

CTL09A INVALID MOISTURE-ENTRY-CODE

In the HDEF command, the moisture-entry-code must be entered as a 1-digit number from 1 to 3 only.

CTL10R CAT.-DIRECTORY I/L FAILURE

See CTL01R for explanation.

CTL11A INVALID SLOPE-CLASS

SLOPE-CLASS must be entered as a 1-digit number, 1 through 3 only.

CTL12I CATALOG SUBSTITUTION

A station with the same number as the one being cataloged already exists in the catalog. The new entry overrides the old one. Warning: after the CTLG command has caused this substitution, the MODL, HDEF, OPT, HERB, and WOOD commands must be entered to make the catalog entry complete. The old values are not retained.

CTL13A INVALID REGION-NUMBER

REGION-NUMBER must be a 1 or 2-digit number from 1 to 10 only.

CTL16A ELEVATION NEGATIVE, OR IMPOSSIBLE FOR U.S.A.

STATION-ELEVATION must be a positive number from 0 to 20300 feet MSL.

CTL17A OPERANDS NOT IN MODEL-AND-VALUE PAIRS

In a HERB or WOOD command, a model identifier was given without a data value after it, or vice-versa.

CTL18A MODEL NOT CATALOGED FOR THIS STATION

In a HERB or WOOD command, a model identifier was specified that had not previously been cataloged for the station with a MODL command.

CTL19A INVALID HERB-VEG-CONDITION

In a HERB command, a condition value was specified as less than 0 or more than 97. 99 resides in the catalog until a valid HERB command has been entered.

CTL20A INVALID WOODY-VEG-CONDITION

In a WOOD command, a condition value was specified which was 5, 7, or 9. 0 resides in the catalog until a valid WOOD command has been entered.

CTL21A INVALID NUMBER OF DISPLAY CLASSES

In a MODL command, the number of Manning-Classes was not between 3 and 9, as required.

CTL22R STATION DOES NOT BELONG TO USER

Once a station has been cataloged, only the user who originally cataloged it may make modifications to the catalog entry. If you wish a particular station moved to your jurisdiction, and the original cataloging user agrees, have that user delete the station from the catalog with a DEL command. Then catalog it yourself, under your user-number. This security check is designed to protect your station catalog entries from unauthorized tampering.

CTL23A INVALID MANNING-INDEX SPECIFICATION

Manning-index must be specified as IC, SC, EC, OI, BI, or FLI only. If the operand is not used, BI is used by default.

CTP01R CATALOG's DIRECTORY FULL, ENTRY NOT STORED

A station has been entered for cataloging but the catalog is already full. Report to AFFIRMS staff since the catalog must be expanded before any new stations can be cataloged.

CTP06R STATION DOES NOT BELONG TO USER

See CTL22R for explanation.

DFC01A NON-NUMERIC CHARACTER

In an operand expected to contain only a numeric value, a character other than 0 thru 9, +, - and decimal point has been found. The up-arrow indicates the defective character.

DFC02A IMPROPER SEQUENCE

In a numeric operand, one of the following errors has occured: + after +, + after -, - after -, - after +, - or + after digit, more than one decimal point, or + or - after decimal point. The up-arrow indicates the defective character.

DFC03A DEC. PT. IN INTEGER FIELD

In a numeric operand, a decimal point was found when not legal for the operand in question.

DOP01I BUSY (SHARED OPEN),STANDBY:xx
DOP02I BUSY (SHARED LOCK),STANDBY:xx
DOP03I BUSY (SHARED UNLOCK),STANDBY:xx

When attempting to access a random-access community data file (C.O.F., catalog, etc.) the file was found to be busy (another user of AFFIRMS was writing in it). Your execution is suspended for 5 seconds and another try is made. The message will be repeated every third try if necessary. If the message occurs many times, you may escape the loop by hitting break to return to the COMMAND? point.

DSP01A WRONG NUMBER OF OPERANDS

Too few or too many operands were given for the command.

DSP02A INVALID SCOPE

In a DSPI, DSPW, or DSPX command, the second operand was not recognized. Use only REG, FOR or UNIT, ID, STAT, CNTY, SIG, ZONE, or LIST.

DSP03A IMPROPER LENGTH

The operand pointed to by the up-arrow has the wrong number of digits or letters.

DSP05A INVALID REGION-NUMBER

The REGION-NUMBER given was not a 1- or 2-digit number between 1 and 10.

DSP06A BOTH STATION NUMBERS ARE MISSING

In a DSPW, DSPI, or DSPX command with ID scope at least one station number must be given. The other may be defaulted by being missing. If the first is defaulted, it is treated as 010101 If the second is defaulted, it is treated as 509999.

DSP08A INVALID STATE-CODE

STATE-CODE must be a 2-digit number between 01 and 50.

DSP09A INVALID COUNTY-CODE

COUNTY-CODE must be a 4-digit number between 0101 and 5099.

DSP10A INVALID FOREST-CODE

FOREST NAME or UNIT NAME must be given as a 4-letter code.

DSP11A IMPROPER STATION I.D.

Station I.D. must be a 6-digit number between 010101 and 509999.

DSP12I NO DATA MEET YOUR CRITERIA

In a DSPW, DSPI, or DSPX command, no data currently in the files meet the specifications given in the command. Your SET DAYS specification may be wrong.

DSP14A S.I.G. NUMBER OUT OF RANGE

In a DSPW, DSPI, or DSPX command with SIG scope, the number of the special interest group is incorrect. Numbers must be a 3-digit number between 001 and 200. Check with AFFIRMS staff.

DSP15A INVALID TYPE-QUALIFIER

In a DSPW, DSPI, or DSPX command, only OBS, SPC, or FCST are allowed as qualifiers.

DSP16A INVALID WEIGHTING FACTOR

Weighting factor must be a number between 1 percent and 99 percent

DSP17A INVALID SLOPE-CLASS SPECIFICATION

See CTL11A.

DSP18A SUM OF WEIGHTING FACTORS IS NOT 100 PERCENT

In a DSPU command, the weighting factors must sum to 100 percent.

DSP19I NO DATA ON SELECTED DATE FOR STATION:xxxxxx

In response to a DSPU command, AFFIRMS could not locate data for the indicated station with the current SET DAYS specification. There may be data available for the station but not of the specified age!

DSP20I MODEL/SLOPE NOT AVAILABLE IN DATA FOR STATION:xxxxxx

In response to a DSPU command, AFFIRMS found data for the specified station, but the model-slope combination specified in the command could not be found in the data. Check the station catalog entry by using the DESC command.

DSP21A NO DATA AVAILABLE FOR UNIT

AFFIRMS could find no data (given the current SET DAYS specification) for any of the stations in a DSPU command.

EXC02A IMPROPER OR FUTURE DATE

In a DATE command, the fields must be entered in the order YEAR-MONTH-DAY, and the combination must be legitimate. Fields must be entered as 2 digits each.

EXC03A COMMAND NOT LEGAL AFTER 'DATE'

After a DATE command, the next command must be ARCH, FCST, OBS, ZONE, STOW, or BYE.

EXC04I	DATE OVERRIDDEN YY/MM/DD The DATE command just entered will remain in effect until the Break-Key is hit. This message will be printed after every command except ARCH entered from the keyboard to remind the operator that the date has been changed.
EXC06I	MSG 'xxxxxxx' FROM USER NO. xxx DATED xxxxxx: Precedes posted message; contains name of file, the user number of the originator, and the date it was posted.
EXC08I	FILE-MODE CANCELLED The Break-Key was hit when AFFIRMS was in file-mode and was reading its commands from a specified text file. The processing of the file ceases, and the terminal goes back to keyboard mode.
EXC09I	DATE REVERTED The Break-Key on the terminal was hit while a DATE command was in effect, causing the current date to be reinstated.
EXC10A	INVALID OPERATION The SET command allows seven operations: HEAD, DAYS, MEDIAN, MEAN, NAME, AC and MC.
EXC12A	INVALID DISPLAY-RANGE The SET DAYS command permits range from -1 to 31 days only.
EXC14A	UNEXPECTED END-OF-FILE, LAST COMMAND NOT COMPLETED While AFFIRMS was in file-mode (reading its commands from a text file rather than the keyboard), one of the commands in that file (such as POST, FILE LIST, etc.) required entry of a file name, but the file containing the commands did not contain a file name record. The file name record must follow the command that refers to it. Check the contents of the file with FILE LIST.
EXC17A	INVALID MANNING-CLASS 'FLOOR', ZERO USED In a SET MC command, the adjective class 'floor' must be specified as: 0,1-,1+,2-,2+,3-,3+,4-,4+,5.
EXC18A	INVALID ADJECTIVE-CLASS 'FLOOR', ZERO USED In a SET AC command, the adjective class 'floor' must be specified as: 0, LO, MD, HI, VH, or EX only.

EXC19I PLEASE TYPE: "BYE" WHEN THE SYSTEM TYPES "READY". THANKS.

AFFIRMS attempted to terminate the session in response to your BYE command, but AFFIRMS lost control and you are connected to the operating system itself. Type BYE again. This should properly end the session.

EXC31I REMINDER! NAMES OF CURRENTLY-SAVED FILES ARE LISTED BELOW, FOLLOWED BY LAST-DATE-ACCESSED.

This message precedes the listing of saved file names produced by the command BYE CAT or by the command BYE when used on Mondays.

FIL01A INVALID OPERATION

The FILE command permits only the READ, MAKE, LIST, NAME, and PRGE operations.

FIL02I NOW EXECUTING FILE 'xxxxxxxx'

A FILE READ command preceded, and AFFIRMS is taking its commands from the specified file. The keyboard is not connected to AFFIRMS and commands should not be entered until the END-OF-FILE ENCOUNTERED message is received. (This does not preclude use of the Break-Key to escape back to terminal-mode. If AFFIRMS takes an inordinate amount of time to respond to the commands in the file, you can check on your status by typing STATUS followed by carriage-return. The computer system will type RUN if you are still connected to the computer and AFFIRMS is still running.

FIL03R SEQUENTIAL FILE READ-ERROR, CODE: xx

After a FILE LIST command was entered, a machine failure occurred while trying to read. Re-try the command; if the problem persists, contact the AFFIRMS staff.

FIL04R 'CREATE' FAILED (PROBABLY IMPROPER FILE-NAME), CODE: xx

A machine failure occurred when setting up a new file, contact AFFIRMS staff if the the errors persist after using another file name.

FIL05I EXISTING FILE. DO YOU WANT TO OVERWRITE (YES/NO)?

A FILE MAKE command specified the name of a file that has been previously created and is still stored. If you answer NO, the command is bypassed. If you answer YES, the file is re-created, empty, and ready for new text.

FIL07A PURGE FAILED (MAYBE NOT YOUR FILE), CODE: xx

A FILE PRGE (or FILE MAKE for an existing file) was unsuccessful, either because of a system error, or because the named file belonged to another user. Check with AFFIRMS staff.

FIL08R 'PERMIT' FAILED (TRY A DIFFERENT FILE-NAME), CODE:xx

A FILE MAKE command specified the name of a file already stored by another AFFIRMS user.

FIL10R 'DSM' FAILED, CODES: XX/XX

A system failure prevented your entered text from being stored in the named file. Contact AFFIRMS staff.

FIL11I HIT 'RETURN', THEN 'BREAK' AFTER LAST LINE OF TEXT

AFFIRMS is storing your text directly in a file. It will not respond to any commands until after the break is hit to indicate no more text.

FIL12R PRELIM. PURGE FAILED, (PROBABLY NOT YOUR FILE), CODE;xx

See FIL07A for explanation.

FIL13A LAST 3 CHARACTERS OF FILE NAME AND USER NUMBER DON'T MATCH.

All user file names must end with the last three digits of the user number under which the current session is being conducted. This will prevent identical file names being created by different users. It also makes it easier to trace files to the originator. The one exception to this rule is the names assigned to text files containing the weather forecast narrative--those must begin with FWX.

INT01A WRONG NUMBER OF OPERANDS

The number of operands given is either too few or too many for the kind of specialinterest group operation being performed.

```
SIG nnn,ADD;   Requires at least 3
SIG nnn,DEL;   Requires at least 3
SIG nnn,LIST;  Requires only 2
SIG nnn,CLR;   Requires only 2
```

INT02A IMPROPER STATION I.D.

See DSP11A.

INT03A INVALID OPERATION

The SIG command allows only the ADD, DEL, LIST, and CLR operations.

INT04I GROUP EMPTY

The special interest group specified contains no station-numbers. Either none have ever been added, or all have been deleted previously.

INT05A GROUP FULL

The specified special interest group already has twenty station-numbers and no more can be added. If the group became full during an ADD operation. The up-arrow will point to the first station ***not*** added to the group. Those appearing to the left of the arrow were successfully added.

INT06A S.I.G. NUMBER INVALID

The I.D. of a special interest group must be a 3-digit number between 001 and 100. Contact system staff.

INT07A S.I.G. BELONGS TO ANOTHER USER

Another AFFIRMS user has already placed station numbers in the special interest group which you have tried to modify. Use SIG 999,LIST to locate a free group.

INT08A I/O ERROR IN S.I.G. FILE, RE-TRY COMMAND

During processing of a SIG command, the interest-definition file could not be accessed because of a machine failure. Try the command again.

INT09I GROUP UNASSIGNED

The cited S.I.G. is not currently assigned to any user.

INT10R ALL GROUPS ASSIGNED, NONE AVAILABLE

Contact AFFIRMS staff immediately!

INT11I AVAILABLE GROUP:xx

In response to SIG 999,LIST AFFIRMS supplies the number of a special interest group currently 'free' and available for your use.

INT12I	USER NUM:xxx LAST MOD:xx/xx GROUP CONTAINS STATION(S): This message is the response to a SIG nnn LIST command. AFFIRMS indicates the 'owning' user's number, the month-and-year when the last modification was made (i.e., the last time a SIG nnn ADD or SIG nnn DEL command referenced this group), and the station numbers currently in the group.
LST01A	IMPROPER QUALIFIER A STOW command was entered which specified neither ZONE or ID.
LST02I	LIST NOW STOWED A STOW command was successfully processed.
LST03A	IMPROPER STATION I.D. Similar to DSP11A.
LST04A	IMPROPER FIRE WEATHER ZONE NUMBER Similar to ZON11A.
MDS01A	MODEL (X) NOT RECOGNIZED The specified MODEL-NAME is not legal. The MODEL-NAME must be a single alphabetic character between A and L only.
OBP01A	STATION NOT IN CATALOG The specified station has not been previously cataloged, or has been previously deleted.
OBP02A	INVALID OBS-TIME OBSERVATION-TIME must be a 2-digit number between 01 and 24, or a 4-digit number between 0100 and 2400, with the last 2 digits between 00 and 59.
OBP03A	INVALID STATE-OF-WEATHER CODE STATE-OF-WEATHER must be entered as a 1-digit number between 0 and 9 only.

OBP04A INVALID TEMPERATURE

DRY-BULB-TEMPERATURE must lie within the limits -100 to +136. A decimal point may be included.

OBP05A STATION HAS UNDEFINED -HDEF-

An HDEF command has never been used for this station, or was not given after the station was re-cataloged. Since no specification has been given, AFFIRMS has no way of knowing whether the humidity data in OBS or SPC commands is relative humidity, wet-bulb temperature, or dewpoint. Use the HDEF command to make the proper specification, and re-enter the observation.

OBP06A IMPROPER WET-BULB, DEWPOINT, OR REL.-HUM. ENTRY

The relative humidity, either observed or computed using the DEWPOINT or WET-BULB, has been found to exceed 100 percent, or is less than 1 percent.

OBP07A NOT ASSIGNED

OBP08A INVALID MAN-RISK OR LIGHTNING ACTIVITY LEVEL

RISK-LEVEL must be entered as a 1- to 3-digit number between 0 and 100 only; lightning-activity must be entered as a 1-digit number between 1 and 5.

OBP09A INVALID WIND DIR .

WIND DIRECTION can be entered in any of the 4 systems in common use-- 16-point-letter code (NE,S,SSW,etc.), 16-point-number code (01 for NNE, 08 for South, 16 for North, etc.), 8-point-number code (1 for NE, 8 for N, etc.), or degrees-of-the-compass (023,180,270, etc.). The data are self-identifying if properly entered. Remember that degrees-of-the-compass must always be 3 digits (use zeros as needed). 16-point number code must always be 2 digits (use a leading zero for values between 1 and 9).

OBP10A INVALID WIND-SPEED

WIND SPEED must be entered as a 1- or 2-digit number from 0 to 99 only.

OBP11A NOT ASSIGNED

OBP12A INVALID 10-HR-T/L FUEL MOISTURE

The fuel stick moisture content must be a number between 0 and 200. A decimal point is allowed (example, 12.5).

OBP13I INCONSISTENT MAX. TEMP., OBSERVED TEMP. USED: xxx

The MAXIMUM TEMPERATURE entered must be equal to or greater than the OBSERVED TEMPERATURE, and must lie between -100 and +136. If the entered value violates these limits, the observed temperature is used instead.

OBP14I INCONSISTENT MIN. TEMP., OBSERVED TEMP. USED: xxx

The MINIMUM TEMPERATURE entered must be equal to or less than the OBSERVED TEMPERATURE, and must lie between -100 and +136. If the entered value violates these limits, the observed temperature is used instead.

OBP15I INCONSISTENT MAX. HUMIDITY, OBSERVED HUM. USED: xxx

This statement indicates that you reported the 24-hour MAXIMUM HUMIDITY as less than the humidity at observation time, an obvious error. The humidity at observation time has automatically been entered as the maximum humidity during the 24 hours from yesterday's observation to today's observation.

OBP16I INCONSISTENT MIN. HUMIDITY, OBSERVED HUM. USED:xxx

Similar to OBP14I except limits are 1% and 100%.

OBP17A INVALID PRECIP. DURATION(S)

PRECIP. DURATIONS are limited to 16 and 8 hours, respectively, and their sum must be 24 or less.

OBP18A 'MAKE THEE AN ARK, GATHER THE ANIMALS 2 BY 2..

24-hour PRECIPITATION AMOUNT must be between 0 and 24.99 inches. A decimal point is required; for example, .12 for twelve-hundredths.

OBP19A INVALID LIGHTNING REPORT

LIGHTNING ACTIVITY LEVEL must be reported as a 1-digit number from 1 to 5 only.

OBP20I MODEL (X) AND OPTION (X) REQUIRE MIN/MAX TEMP/HUM

The model-option combination specified for this station requires an input which you entered as missing (M). Re-enter the observation with the required data, or change the option specifications for the station using the OPT command.

OBP21I	MODEL (X) AND OPTION (X) REQUIRE 10-HR-T/L FUEL MOISTURE ENTRY Similar to OBP20I.
OBP22A	MISSING MOISTURE VARIABLE RELATIVE-HUMIDITY, DEWPOINT, or WET-BULB-TEMPERATURE (depending on the HDEF specifications for the station) is required data and must not be entered as missing.
OBP27I	WRONG NUMBER OF OPERANDS OBS commands must have 18 operands, FCST commands must have 16, and SPC commands must have 17.
OBP29I	MODEL (X) NEEDS WOODY-VEG-CONDITION One or more models for this station need the WOODY-VEGETATION-CONDITION (for live fuels). The indices for other models for the station are computed, but those involving live fuels are not.
OBP30I	MODEL (C) HAS UNDEFINED HERB-VEG-COND. INDICES NOT COMPUTED FOR THIS MODEL The catalog for this station does not contain a valid entry for the herbaceous vegetative condition for the Fuel Model shown in parenthesis. A MODL command erases the herbaceous and wood vegetative conditions. New HERB and WOOD (for Models B and F) commands must follow the MODL command.
OBP31R	STATION DOES NOT BELONG TO USER An OBS command has been entered by a user other than the one who originally cataloged the station involved. If you wish to enter data for this station, and the user who owns the station agrees, have him delete the station; then catalog it under your user number.
OBP33A	'OBS' TIME MUST BE WITHIN 2 HOURS OF XXXX For OBS or ARCH commands, the time of observation must be within 2 hours of the STANDARD OBS TIME specified in the station catalog.
OBP34A	STOW CONTAINS NO STATION-NUMBERS Similar to ZON08A but issued for FCST command.

OBP35I UNUSUALLY LOW STICK MOISTURE (UNDER 2.0) ACCEPTED, BUT PLEASE CHECK CALIBRATION OF SCALES AND STICKS

Stick moistures under 2 percent are very uncommon. Although AFFIRMS will accept such values, it is wise to recheck the calibration of your system for possible defects.

OBP36I 10% USED FOR 'LAST' FUEL MOISTURES, NO RECENT OBS

Whenever an OBS command is entered, AFFIRMS fetches the last observation for the station and obtains the 10-HR and 100-HR moistures. These are used in computing "today's" values. If no 'last' OBS could be found less than 4 days old, AFFIRMS assumes 10% for each 'last' value.

OBP37A NEW OBS NOT PROCESSED, PRE-DATES LAST OBS (DATED:xxxxxx)

An OBS command may be used with DATE to enter several days of stale data, usually to properly trend the 100-HR fuel moistures. Such stale OBS must be entered IN ORDER, beginning with the oldest first.

OBP38A NON-ZERO PRECIP. AMOUNT MUST HAVE DECIMAL POINT.

To reduce entry errors AFFIRMS requires that the decimal point be included unless the precipitation amount is zero. For example 32 hundredths must be entered as 0.32 or .32.

OBP39A PRECIP. DURATION INCONSISTENT WITH PRECIP. AMOUNT.

If precip. duration is entered as zero then logically precip. amount must be zero as well. On the other hand, if either is entered as a real value then both must be greater than zero.

OBP40I NO FCST LAL AVAILABLE, USED OBS. MORNING LAL: X

Today's lightning risk is computed using yesterday's LAL and the highest of today's observed LAL (ML) or the LAL forecasted for today. When a forecasted LAL is not available for today, the morning LAL is used.

OPN01I SEQUENTIAL FILE BUSY, STANDBY

A text file was in use by another user when AFFIRMS tried to access it for you. AFFIRMS keeps trying every 5 seconds; the message is printed every 15 seconds (every 3rd try). If you wish to abandon the task, you can hit break. However, the work specified in your last command will not be performed.

OPN02R SEQUENTIAL FILE OPEN-FAILURE, CODE:xx

A machine failure prevented access to a text-file. Please report the code number to system staff.

OPN03I SEQUENTIAL FILE 'xxxxxx' NOT SAVED

A FILE command was entered, specifying an 'existing' file which could not be found in the library.

OPR01R UNEXPECTED END OF BUFFER

This is a theoretically impossible condition. Report to AFFIRMS staff, along with the command which produced it.

PST01I FILE NOT CURRENTLY POSTED

A POST command with no operands (treated as a DE-POST) specified a file not currently cited in the route-file.

PST02R I/O ERROR IN ROUTE FILE, RE-TRY COMMAND

A machine failure prevented a POST command from being entered into the route-file. Try the command again; if the error persists, contact AFFIRMS staff.

PST03I REQUEST SERVICED

Processing of a POST command terminated normally.

PST04A	INVALID USER-NUMBER	USER-NUMBERS must be 3 digits long, from 001 to 998 only.
PST05R	ROUTE FILE FULL	All records in the route-file are currently in use. Until one of the POST entries self-destructs (that is, when delivered to all cited users), no further POST commands can be accepted. (Contact AFFIRMS staff).
SSM02R	C.O.F. NOT IMPLEMENTED, REGION: XX	The Current-Observation-File for the specified Region has not been constructed. Contact AFFIRMS staff.
SYN01A	NOT ASSIGNED	
SYN02A	INVALID SYNTAX OR LINE GARBLE	This message can arise from any number of defects in command syntax. Check that the statement is entered correctly with a legitimate command VERB and that the command VERB is followed by a blank (if there are operands).
SYN03I	NOT ASSIGNED	
SYN04A	TOO MANY OPERANDS	The command has more operands than are legal with the particular type of command.
SYN05A	UNRECOGNIZED COMMAND (OR LINE GARBLE)	The command VERB is unrecognizable. The most likely cause is failure to place the single blank between the VERB and the first operand (for those commands with operands).

SYN06I END-OF-FILE ENCOUNTERED

AFFIRMS was in file-mode and reached end-of-data in the file. The terminal awaits a new command to be entered from the keyboard.

SYN07A CONSECUTIVE DELIMITERS

Two operand separators were found without any operand data between them. This could arise from comma-after-comma, comma-after-blank, or any other such combination. This message usually arises from placing more than one blank between two operands.

ZON01A WRONG NUMBER OF OPERANDS

Too many or too few operands were specified for a ZONE command.

ZON02A IMPROPER LENGTH

The operand flagged with an arrow has too few or too many characters.

ZON03A IMPROPER REGION NUMBER

REGION-NUMBER must be between 1 and 10.

ZON04A ILLEGAL FORECAST TIME

FORECAST-VALID-TIME must be 2 digits between 01 and 24, or 4 digits between 0100 and 2400.

ZON05A EXCESSIVE TREND

One or more data trends exceeded the limits imposed in the User's Guide. A zero-trend may be entered as "M" instead of "0" (zero).

ZON06A INVALID PRECIP. DURATION (S)

PRECIP. DURATIONS are limited to 16 and 8 hours, respectively, and their sum must not exceed 24.

ZON07A INVALID LIGHTNING-ACTIVITY LEVEL

LIGHTNING ACTIVITY is limited to the range 1 to 5.

ZON08A STOW CONTAINS NO ZONE NUMBERS

A ZONE command specifying STOW rather than a single zone number has not been preceded by a STOW ZONE command.

ZON10I NO CURRENT OBS IN ZONE(S)

A ZONE command was entered but AFFIRMS could find no current (today's) OBS for any of the stations in the zone: no forecasts were generated.

ZON11A IMPROPER ZONE NUMBER

Forecast zone numbers must be entered as a 3-digit number between 001 and 999.

ZON12R ELIGIBILITY TABLE OVERFLOW, LAST STATION TRENDED:xxxxxx

A ZONE command may not trend more than 40 stations, either in a single zone or in a group of zones cited by STOW.

APPENDIX J

Encoding Forms and Worksheets

Exhibit I 'OBS' AFFIRMS Coding Sheet J-2
II 'SPC' and 'ARCH' AFFIRMS Coding Sheet J-3
III 'FCST' AFFIRMS Coding Sheet J-4
IV 'ZONE' AFFIRMS Coding Sheet J-5
V Station Catalog Worksheet J-6

EXHIBIT 1

'OBS'

AFFIRMS CODING SHEET

COM-MAND	STATION NUMBER **(6)	OBS TIME (2)	1. W (1)	DRY TEMP. (1)	HUM.* ENTRY (1)	2. ML (1)	MR (1)	WIND		10hr T/L (1)	TEMP.		% RH		PRECIP.		3. YL (1)	4. MR (1)		5 UNKO (0)
								DIR. (1)	SPD. (1)		MAX. (1)	MIN. (1)	MAX. (1)	MIN. (1)	DUR. (1)	AMOUNT (1)				
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------
OBS	------	--	-	----	---	-	---	---	--	----	---	----	---	---	---	-----	-	---		----------

1. State of the Weather

2. LAL for period since midnight to basic obs. time (ML).

3. Yesterday's 24-hour (0001 - 2400) lightning activity (YL).

4. Tomorrow's Forecasted Man-Caused Risk

*Relative Humidity, Dew-point Temp. or Wet-bulb Temp.

**Minimum Number of Digits. "Dashes" indicate maximum length.

5. Miscellaneous information listed only on DSPW command. Data not archived.

EXHIBIT 2

'SPC' and 'ARCH'

AFFIRMS CODING SHEET

COM-MAND **(3)	STATION NUMBER (6)	OBS TIME (2)	1. W (1)	DRY TEMP. (1)	HUM.* ENTRY (1)	2. ML (1)	MR (1)	WIND		10hr T/L (1)	TEMP.		% RH		PRECIP.		3. YL (1)
								DIR. (1)	SPD. (1)		MAX. (1)	MIN. (1)	MAX. (1)	MIN. (1)	DUR. (1)	AMOUNT (1)	
----	------	--	-	----	-----	-	---	---	--	----	---	----	---	---	---	-----	-
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*** DATE

1. State of the Weather

2. LAL for period since midnight to basic obs. time (ML)

3. Yesterday's 24-hour (0001-2400) lightning activity level (YL).

*Relative Humidity, Dew-point Temp. or Wet-bulb Temp.

**Minimum Number of Digits "Dashes" indicate maximum length.

***Not entered-- for documentation only

EXHIBIT 3

'FCST'

AFFIRMS CODING SHEET

COM-MAND	STATION NUMBER **(6)	VALID TIME (2)	1. W (1)	DRY TEMP. (1)	RH (1)	LTG ACT AL (1)	LTG ACT TL (1)	WIND DIR. (1)	WIND SPD. (1)	10hr T/L (1)	TEMP. MAX. (1)	TEMP. MIN. (1)	% RH MAX. (1)	% RH MIN. (1)	PRECIP DUR. D1 (1)	PRECIP DUR. D2 (1)
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--
FCST	------	--	-	----	---	-	-	---	--	----	---	----	---	---	--	--

*** DATE

1. State of the Weather

**Minimum Number of Digits - "Dashes" indicate maximum length.

***Not entered- for documentation only.

'ZONE'

AFFIRMS CODING SHEET

COM-MAND	ZONE NUMBER **(3)	REGION NUMBER (1)	VALID TIME (2)	1. W (1)	TEMP. TREND (1)	RH TREND (1)	WD SPD TREND (1)	PRECIP DUR.		TIMP. TRENDS		RH TRENDS		LTG ACT		10hr T/L TREND (1)	*** DATE
								D1 (1)	D2 (1)	MAX. (1)	MIN. (1)	MAX. (1)	MIN. (1)	AL (1)	TL (1)		
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------
ZONE	---	--	--	-	---	---	---	--	--	---	---	---	---	-	-	-----	------

1. Forecasted State of the Weather

** Minimum Number of Digits

***Not entered--
for documentation only.

EXHIBIT 4

EXHIBIT 5

STATION CATALOG WORKSHEET   STATION NUMBER _ _ _ _ _ _   DATE__________   PREPARED BY__________

FULL STATION NAME ______________________________

```
                                                                                                 USER'S GUIDE
AFFIRMS COMMAND                                        OPERANDS                                  PAGE REFERENCE

                             Local                              Local
          Station           Standard                             Std.    Fire         Station
CTLG      Number,Elevation,Time Zone,Unit Name,Region #,Agency,OBS Time,Weather Zone,Abbrev.         2.1.1

          ------,-----(1-5),---,     ----,     -- (1-2), -,    --,      ---,         ------ (1-6)
          Station
HDEF      Number,Humidity Code: 1 = Wet-bulb Temp
                                2 = RH
          ------,    -,         3 = Dewpoint Temp                                                     2.1.2
          Station
OPT       Number,Input Option Code,Manning Index Code

          ------,    -,                  --- (2-3)                                                    2.1.3
          Station  Number of                     Break Points for  Optional to Enter Model, Slope,
MODL      Number,Manning Class,Model,Slope Class,Manning Index     Break Points for Add. Fuel Models

          ------,    -,         -,      -,       ----(if unknown enter 0000),-,-,----, -,-,----,      2.1.4
          Station
HERB      Number,Model,Herbaceous-Vegetation Condition  Additional Fuel Models

          ------,    -,    --,(percent green)(1-2)        -,--,    -,--,                              2.1.5
          Station
WOOD      Number,Model,Woody-Vegetation Condition Code(models B and F only)

          ------,    -,     -,(enter 5,7 or 9 only)  -,                                               2.1.6
          Station
DESC      Number

          ------                                                                                      2.1.7
```

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88: RM 16

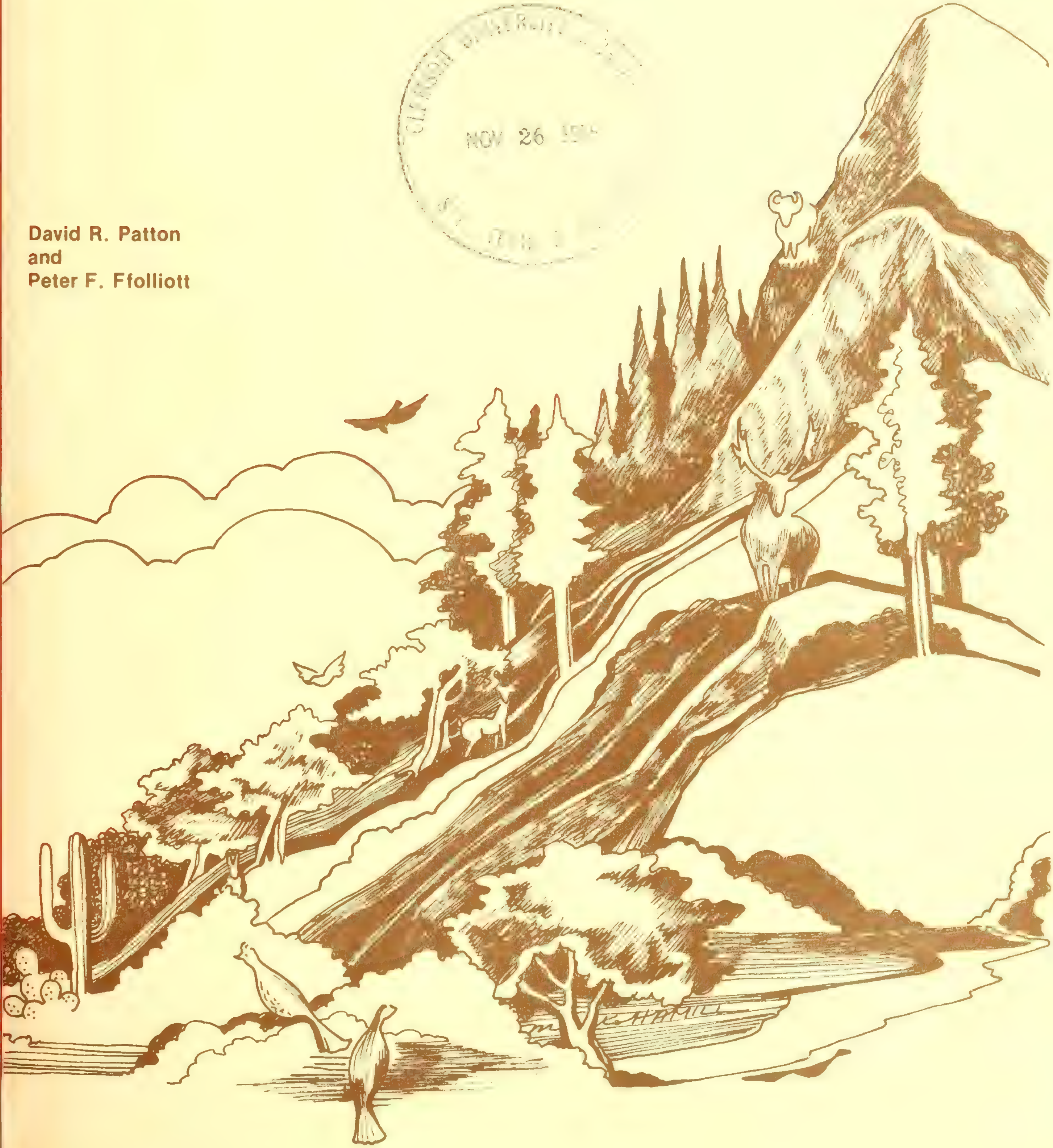
Selected Bibliography of Wildlife and Habitats for the Southwest

USDA Forest Service
General Technical
Report RM-16

September 1975

CLEMSON UNIVERSITY
NOV 26 19[illegible]

David R. Patton
and
Peter F. Ffolliott



U.S. Department of Agriculture Forest Service
Rocky Mountain Forest and Range Experiment Station
Fort Collins, Colorado

ABSTRACT

Patton, David R., and Peter F. Ffolliott.
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This bibliography contains 390 references on research and management of important wildlife species and habitats in Arizona and New Mexico. References selected cover a period from 1913 to early 1975. A subject index is keyed to an alphabetical list of authors.

Keywords: Wildlife habitat, bibliography.

USDA Forest Service
General Technical Report RM-16

September 1975

SELECTED BIBLIOGRAPHY OF WILDLIFE AND HABITATS FOR THE SOUTHWEST

David R. Patton[1] and Peter F. Ffolliott[2]

---

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SELECTED BIBLIOGRAPHY OF WILDLIFE AND HABITATS FOR THE SOUTHWEST

by

David R. Patton and Peter F. Ffolliott

Introduction

In recent years the amount of wildlife literature accumulating in professional journals has made it difficult for field biologists to maintain a reference library. As a result of many requests for literature we have gradually compiled a bibliography on wildlife habitat management reflecting the types of information sought by biologists in the Southwest.

Even though we excluded some periodicals and information on selected species this bibliography contains 390 references. Students, research and management biologists, and professors alike should find it useful in their search for information on wildlife and habitats in the Southwest.

References included in this publication cover a period from 1913 to early 1975 but we did not attempt to make them all inclusive. To make the bibliography more than a list we have provided a subject index keyed to author. A number under the subject identifies the article which is listed by author in alphabetical order. Once a reference is located and the article is obtained then more than likely it will list references we have missed or excluded.

Because of the large amount of material available we excluded references on small rodents, amphibians, reptiles, and bats. Articles that are not readily available and those from popular publications also were not included. With the exception of some final reports we did not reference federal aid job completion reports published by the Arizona and New Mexico Game and Fish Departments. In addition we chose not to include periodicals devoted to a single species such as Transactions Desert Bighorn Council.

Subject Index

Antelope

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85, 167, 189, 193, 229, 265, 267, 270, 271, 280, 281, 288, 292, 348

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6, 11, 14, 15, 27, 31, 35, 44, 45, 112, 126, 129, 211, 241, 243, 246
264, 268, 271, 325, 327, 328, 329, 330, 333, 338, 340, 341, 350, 353
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34, 156, 175, 201, 211, 239, 308, 316, 317, 345, 346, 376

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225, 227, 255, 256, 261, 297, 301, 303, 355, 365, 366, 367, 368
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8, 16, 20, 32, 41, 42, 44, 45, 63, 88, 98, 100, 105, 109, 121
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41, 42, 44, 45, 46, 79, 105, 145, 194, 207, 209, 269, 286

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22, 79, 105, 207, 216, 228, 304

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2, 42, 44, 45, 68, 79, 132, 181, 182, 183, 207, 223, 226, 244
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3, 13, 19, 22, 42, 44, 45, 64, 66, 67, 70, 129, 167, 178, 189
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A

1. Aitchison, S. W., and M. E. Theroux.
   1974. A biotic inventory of Chevelon Canyon, Coconino and Navajo Counties, Arizona. Dep. of Biol. Mus. of N.A., Flagstaff. 69 p.

2. Aldon, E. F., and H. W. Springfield.
   1973. The southwestern pinyon-juniper ecosystem: a bibliography. USDA For. Serv. Gen. Tech. Rep. RM-4, 20 p.

3. Alexander, R. R.
   1974. Silviculture of central and southern Rocky Mountain forests: Summary of the status of our knowledge by timber types. USDA For. Serv. Res. Pap. RM-120, 36 p.

4. Alexander, R. R.
   1974. Silviculture of subalpine forests in the central and southern Rocky Mountains: The status of our knowledge. USDA For. Serv. Res. Pap. RM-121, 88 p.

5. Anderson, A. E., L. G. Frary, and R. H. Stewart.
   1964. A comparison of three morphological attributes of mule deer from the Guadalupe and Sacramento Mountains, New Mexico. J. Mammal. 45:48-53.

6. Anderson, A. E., W. A. Snyder, and G. W. Brown.
   1965. Stomach content analyses related to condition in mule deer, Guadalupe Mountains, New Mexico. J. Wildl. Manage. 29:352-366.

7. Anderson, A. E., W. A. Snyder, and G. W. Brown.
   1970. Indices of reproduction and survival in female mule deer, Guadalupe Mountains, New Mexico. Southwest. Nat. 15:29-36.

8. Anderson, A. H., and A. Anderson.
   1946. Notes on use of creosote bush by birds. Condor 48:179.

9. Anderson, A. H., and A. Anderson.
   1961. Life history of the cactus wren. Part IV: Development of nestlings. Condor 63:87-94.

10. Anderson, B., R. D. Pieper, and V. W. Howard, Jr.
    1974. Growth response and deer utilization of fertilized browse. J. Wildl. Manage. 38:525-530.

11. Anthony, R. G., and N. G. Smith.
    1974. Comparison of rumen and fecal analysis to describe deer diets. J. Wildl. Manage. 38:535-540.

12. Arnold, J. F.
    1942. Forage consumption and preferences of experimentally fed Arizona and antelope jackrabbits. Ariz. Agric. Exp. Stn. Tech. Bull. 98:51-86.

13. Arnold, J. F.
1953. Effect of heavy selection logging on herbaceous vegetation in a ponderosa pine forest in northern Arizona. J. For. 51(2):101-105.

14. Arnold, J. F.
1955. Plant life-form classifications and its use in evaluating range conditions and trend. J. Range Manage. 8(4):176-181.

15. Arnold, J. F., and H. G. Reynolds.
1943. Droppings of Arizona and antelope jackrabbits and the "Pellet Census". J. Wildl. Manage. 7:322-327.

16. Arnold, L. W.
1940. An ecological study of the vertebrate animals of the mesquite forest. M.S. Thesis, Univ. of Ariz. Tucson, 79 p.

17. Arnold, L. W.
1943. The western white-winged dove in Arizona. Ariz. Game and Fish Comm. Proj. Ariz. 9-R, 103 p.

18. Arrington, O. N., and A. E. Edwards.
1951. Predator control as a factor in antelope management. North Am. Wildl. Nat. Resour. Conf. Trans. 16:179-193.

19. Axelton, E. A.
1967. Ponderosa pine bibliography through 1965. U.S. For. Serv. Res. Pap. INT-40, 150 p.

B

20. Bailey, V.
1923. Sources of water supply for desert animals. Sci. Mon. 17(1):66-86.

21. Bailey, V.
1931. Mammals of New Mexico. USDA Bur. Biol. Surv. North Am. Fauna. No. 53. 412 p.

22. Balda, R. P.
1969. Foliage use by birds of the oak-juniper woodland and ponderosa pine forest in southern Arizona. Condor 71:339-412.

23. Balda, R. P., and G. C. Bateman.
1971. Flocking and annual cycle of the pinion jay, Gymnorhinus cyanocephalus. Condor 73(3):287-302.

24. Banks, R. L.
1970. An ecological study of scaled quail in southeastern New Mexico. M.S. Thesis, N. Mex. State Univ., Las Cruces, 63 p.

25. Benson, L., and R. A. Darrow.
1944. A manual of southwestern trees and shrubs. Univ. of Ariz. Biol. Sci. Bull. 6, 411 p.

26. Best, T. L.
1971. Notes on the distribution and ecology of five eastern New Mexico mammals. Southwest. Nat. 16:210.

27. Bigler, W. J.
1966. A marking harness for the collared peccary. J. Wildl. Manage. 30:213-214.

28. Bishop, R. A.
1964. The Mearns quail, Cyrtonyx montezumae mearnsi, in southern Arizona. M.S. Thesis, Univ. of Ariz., Tucson, 82 p.

29. Bishop, R. A., and C. R. Hungerford.
1965. Seasonal food selection of Arizona Mearns quail. J. Wildl. Manage. 29(4):813-819.

30. Blankenship, L. H., R. E. Reed, and H. D. Irby.
1966. Pox in mourning doves and Gambel's quail in southern Arizona. J. Wildl. Manage. 30:253-257.

31. Blankenship, L. H., R. E. Tomlinson, and R. C. Kufeld.
1967. Arizona dove wing survey, 1964. U.S. Fish and Wildl. Serv. Spec. Sci. Rep. Wildl. 116, 34 p.

32. Blydenstein, J., C. R. Hungerford, G. I. Day, and R. R. Humphrey.
1957. Effect of domestic livestock exclusion on vegetation in the Sonoran Desert. Ecology 38:522-526.

33. Boeker, E. L., and H. G. Reynolds.
1966. Deer and elk habitat improvement studies in southern New Mexico. Wildl. Soc., N. Mex.-Ariz. Sect., Proc. 5:29-35.

34. Boeker, E. L., and V. E. Scott.
1969. Roost tree characteristics for Merriam's turkey. J. Wildl. Manage. 33:121-124.

35. Boeker, E. L.
1970. Use of aircraft to determine golden eagle, Aguila chrysaetos, nesting activity. Southwest. Nat. 15(1):131-143.

36. Boeker, E. L., and T. D. Ray.
1971. Golden eagle population studies in the Southwest. Condor 73(4):463-467.

37. Boeker, E. L., V. E. Scott, H. G. Reynolds, and B. A. Donaldson.
1972. Seasonal food habits of mule deer in southwestern New Mexico. J. Wildl. Manage. 36:56-63.

38. Bohl, W. H.
1957. Chukars in New Mexico. N. Mex. Dep. Game and Fish Bull. 6, 69 p.

39. Boone, R. P.
1938. Deer management on the Kaibab. North Am. Wildl. Nat. Resour. Conf. Trans. 3:368-375.

40. Borell, A. E.
1942. Water wildlife in the Southwest. Soil Conserv. 7(10):258-262.

41. Brandt, H.
1951. Arizona and its bird life: a naturalist's adventures with the nesting birds on the deserts, grasslands, foothills, and mountains of southeastern Arizona. Bird. Res. Found. 16, 724 p.

42. Brown, D. E.
1973. The natural vegetative communities of Arizona (map scale 1:500,000). Arizona Resources Information Systems (ARIS), Phoenix.

43. Brown, D. E.
1973. Western range extensions of scaled quail, montezuma quail and coppery-tailed trogeon in Arizona. West. Birds 4:57-60.

44. Brown, D. E., and C. H. Lowe.
1973. A proposed classification for natural and potential vegetation in the Southwest with particular reference to Arizona. Ariz. Game and Fish Dep. Fed. Aid Proj. Rep. W53R-22-WP 4-J1, 26 p.

45. Brown, D. E., and C. H. Lowe.
1974. A digitized computer-compatible classification for natural and potential vegetation in the Southwest with particular reference to Arizona. J. Ariz. Acad. Sci., Vol. 9, suppl. 2, 11 p.

46. Brown, D. E., and C. H. Lowe.
1974. The Arizona system for natural and potential vegetation--illustrated summary through the fifth digit for the North American Southwest. J. Ariz. Acad. Sci., Vol. 9, suppl. 3, 56 p.

47. Brown, H. E.
1971. Evaluating watershed management alternatives. Am. Soc. Civil Eng., J. Irrig. and Drain. Div. 97(IR1):93-108.

48. Brown, J. L.
1963. Social organization and behavior of the Mexican jay. Condor 65:126-153.

49. Brown, R. L.
1967. The extent of breeding by immature mourning doves, _Zenaidura macoura marginella_, in southern Arizona. M.S. Thesis, Univ. of Ariz., Tucson, 56 p.

50. Brown, T. C., P. F. O'Connell, and A. R. Hibbert.
1974. Chaparral conversion potential in Arizona. Part II: An economic analysis. USDA For. Serv. Res. Pap. RM-127, 28 p.

51. Brown, W. H., J. W. Stull, and L. K. Sowls.
1963. Chemical composition of the milk fat of the collared peccary. J. Mammal. 44:112-113.

52. Burk, C. J.
1973. The Kaibab deer incident: a long-persisting myth. Bio Sci. 23:113-114.

53. Burt, W. H.
1933. Additional notes on the mammals of southern Arizona. J. Mammal. 14:114-122.

C

54. Cahalane, V. H.
1932. Mammals of the Chiricahua Mountains, Cochise County, Arizona. J. Mammal. 20:418-440.

55. Campbell, H.
1957. Fall foods of Gambel's quail (*Lophortyx gambelii*) in New Mexico. Southwest. Nat. 2:122-128.

56. Campbell, H.
1958. The economic value of hunting and fishing in New Mexico. N. Mex. Dep. Game and Fish Bull. 7, 35 p.

57. Campbell, H.
1959. Experimental feeding of wild quail in New Mexico. Southwest. Nat. 4:169-175.

58. Campbell, H.
1960. An evaluation of gallinaceous guzzlers for quail in New Mexico. J. Wildl. Manage. 24:21-26.

59. Campbell, H.
1972. A population study of lesser prairie chickens in New Mexico. J. Wildl. Manage. 36:689-699.

60. Campbell, H., and B. K. Harris.
1965. Mass population dispersal and long-distance movements in scaled quail. J. Wildl. Manage. 29:801-805.

61. Carothers, S. W., and L. Lee.
1956. Notes on the sex ratio of Gambel's and scaled quail in New Mexico. J. Wildl. Manage. 20:93-94.

62. Castetter, E. F.
1956. The vegetation of New Mexico. N. Mex. Q. 26:257-288.

63. Chew, R. M., and A. E. Chew.
1970. Energy relationships of the mammals of a desert shrub (*Larrea tridentata*) community. Ecol. Monogr. 40:1-21.

64. Choate, G. A.
1966. New Mexico's forest resources. U.S. For. Serv. Resour. Bull. INT-5, 57 p.

65. Clark, E. D.
1953. A study of the behavior movements of the Tucson Mountains mule deer. M.S. Thesis, Univ. of Ariz., Tucson, 111 p.

66. Clary, W. P.
1972. A treatment prescription for improving big game habitat in ponderosa pine forests. p. 25-28. *In* 16th Annu. Ariz. Watershed Symp. [Phoenix, Ariz., Sept. 1972] Proc. Ariz. Water Comm. Rep. 2, 43 p. Phoenix, Ariz.

67. Clary, W. P., and F. R. Larson.
1971. Elk and deer use are related to food sources in Arizona ponderosa pine. USDA For. Serv. Res. Note RM-202, 4 p.

68. Clary, W. P., M. B. Baker, Jr., P. F. O'Connell, T. N. Johnsen, Jr., and R. E. Campbell.
1974. Effects of pinyon-juniper removal on natural resource products and uses in Arizona. USDA For. Serv. Res. Pap RM-128, 28 p.

69. Cockrum, E. L.
1960. The recent mammals of Arizona. Univ. of Ariz. Press, Tucson, 276 p.

70. Cooper, C. F.
1960. Changes in vegetation, structure, and growth of southwestern pine forests since white settlement. Ecol. Monogr. 30:129-164.

D

71. Davis, C. A., D. E. Babb, and W. B. Ballard.
1971. Foods of mourning doves in the Mesilla Valley of south-central New Mexico. N. Mex. State Univ., Agric. Exp. Stn. Res. Rep. 201, 4 p.

72. Davis, C. A., and J. P. Griffing.
1972. Nesting of the white-necked raven in southeastern New Mexico. N. Mex. State Univ., Agric. Exp. Stn. Res. Rep. 231.

73. Davis, W. C.
1962. Values of hunting and fishing in Arizona, 1960. Univ. of Ariz. Bur. Bus. and Public Res. Spec. Stud. 21, 61 p.

74. Day, G. I.
1964. An investigation of white-tailed deer (*Odocoileus virginianus couesi*) forage relationships in the Chiricahua Mountains. M.S. Thesis, Univ. of Ariz., Tucson, 101 p.

75. Day, J., and S. Gallizioli.
1967. Boom and bust--the story of the Chiricahua whitetail deer. Ariz. Game and Fish Dep. Proj. W-78-R, 12 p.

76. Dayton, W. A.
1931. Important western browse plants. U.S. Dep. Agric. For. Serv. Misc. Publ. 101, 214 p.

77. Dick-Peddie, W. A., and W. H. Moir.
1970. Vegetation of the Organ Mountains, New Mexico. Colo. State Univ., Range Sci. Dep., Sci. Ser. 4, 28 p.

78. Donaldson, B.
1967. Hunter's guide to the javelina of New Mexico. N. Mex. Dep. Game and Fish. 16 p.

79. Douglas, C. L., and R. R. Johnson.
1972. Highways and their impact on the wildlife of the pinyon-juniper-oak woodland and grassland in north central Arizona. Ecol. Stud. Proj. N-900-255, AFE 27901, Prescott Coll. Ecol. Surv., 109 p. plus appendix.

E

80. Eddy, T. A.
1959. Foods of the collared peccary, *Pecari tajacu sonoriensis* (Mearns), in southern Arizona. M.S. Thesis, Univ. of Ariz., Tucson, 102 p.

81. Eddy, T. A.
1961. Foods and feeding patterns of the collared peccary in southern Arizona. J. Wildl. Manage. 25:248-257.

82. Elder, J. B.
1953. Utilization of man-made waterholes by wildlife in southern Arizona. M.S. Thesis, Univ. of Ariz., Tucson, 114 p.

83. Elder, J. B.
1954. Notes on summer water consumption by desert mule deer. J. Wildl. Manage. 18:540-541.

84. Elder, J. B.
1956. Watering patterns of some desert game animals. J. Wildl. Manage. 20:368-378.

F

85. Ferner, J. W.
1974. Habitat relationships of Tamiasciurus hudsonicus and Sciurus alberti in the Rocky Mountains. Southwest. Nat. 18:470-473.

86. Ffolliott, P. F., and W. P. Clary.
1972. A selected and annotated bibliography of understory-overstory vegetation relationships. Ariz. Agric. Exp. Stn. Tech. Bull. 198, 33 p.

87. Ffolliott, P. F., and D. B. Thorud.
1974. Vegetation management for increased water yield in Arizona. Ariz. Agric. Exp. Stn. Tech. Bull. 215, 35 p.

88. Findley, J.
1969. Biogeography of southwestern boreal and desert mammals. Univ. of Kans. Mus. Nat. Hist. Misc. Publ. 51:113-128.

89. Finney, B. A.
1966. Small mammal populations in the Capitan Mountains, New Mexico. Ph.D. Diss., Univ. of Colo., Boulder, 213 p.

90. Fleming, W. B.
1959. Migratory waterfowl in Arizona. Ariz. Game and Fish Dep. Wildl. Bull. 5, 71 p.

91. Forcum, D. L., C. D. Rael, et al.
1969. Abundance of cottontails and their fleas at Red Bluff Ranch, New Mexico. J. Wildl. Manage. 33:422-424.

G

92. Gallizioli, S.
1959. Deer carrying capacity of various sub-types within the chaparral habitat. Ariz. Game and Fish Dep. Proj. W-78-R3, WP5 J1, 3 p. (mimeo).

93. Gallizioli, S.
1960. About quail and quail hunting. Ariz. Game and Fish Dep. Proj. W-78-R, 7 p.

94. Gallizioli, S.
1961. The current status and management of the mourning dove in the western management unit. North Am. Wildl. Nat. Resour. Conf. Trans. 26:395-405.

95. Gallizioli, S.
1962. Water and Gambel quail. Ariz. Game and Fish Dep. Wildl. Views 9(3):16-19.

96. Gallizioli, S.
1967. Sex and age differential vulnerability to trapping and shooting in Gambel's quail. 47th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 262-271.

97. Gallizioli, S., and W. Swank.
1958. Effects of hunting on Gambel quail populations. North Am. Wildl. Nat. Resour. Conf. Trans. 23:305-319.

98. Gardner, J. L.
1965. Native plants and animals as resources in arid lands of the Southwestern United States. Contrib. No. 8 of Comm. on Desert and Arid Zones Res., Am. Assoc. Adv. Sci., Rocky Mt. Southwest. Div., 80 p. Ariz. State Coll.

99. Gehlbach, F. R.
1967. Vegetation of the Guadalupe escarpment, New Mexico-Texas. Ecology 48:393-419.

100. Glading, B.
1947. Game watering devices for the arid Southwest. North Am. Wildl. Nat. Resour. Conf. Trans. 12:286-292.

101. Glidewell, E. D.
1970. Suitable habitat as a factor limiting pronghorn numbers on the Jornada Experimental Range. M.S. Thesis, N. Mex. State Univ., Las Cruces, 28 p.

102. Gomer, E. R., J. C. Capp, and V. E. Scott.
1969. 1968 elk distribution in the Sacramento and White Mountains of New Mexico. Bur. Indian Aff., Mescalero Agency, N. Mex., and USDA, 17 p. (multi.).

103. Gorsuch, D. M.
1934. Life history of Gambel's quail in Arizona. Univ. of Ariz. Biol. Bull. 2, 89 p.

104. Gould, P. J.
1961. Territorial relationships between cardinals and pyrrhuloxias. Condor 63:246-256.

105. Greenwalt, L. A.
1955. Mobility of Gambel's quail (*Lophortyx gambeli gambeli*) in a desert-grassland-oak-woodland area in southeastern Arizona. M.S. Thesis, Univ. of Ariz., Tucson, 37 p.

106. Griffing, J. P., and C. A. Davis.
1974. Mourning dove foods in an uncultivated area of New Mexico. J. Wildl. Manage. 38:375-376.

107. Griffith, G. K.
1962. Guide lines for antelope management. Interstate Antelope Conf. Trans. 1962, p. 102-114.

108. Grinnell, G. B.
1929. Pronghorn antelope. J. Mammal. 10:135-141.

109. Gullion, G. W.
1958. The "proximity effect" of water distribution upon desert small game populations. 38th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 187-189.

110. Gullion, G. W.
1960. The ecology of Gambel's quail in Nevada and the arid Southwest. Ecology 41:518-536.

111. Gullion, G. W., and A. M. Gullion.
1964. Water economy of Gambel quail. Condor 66:32-40.

H

112. Hall, J. M.
1950. An elk trend survey technique. 30th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p.145-149.

113. Hall, J. M.
1952. Game-livestock relationships studies in Arizona. 32nd Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 86-89.

114. Hall, J. M.
1955. Livestock and big game relationships. J. Range Manage. 8:4-6.

115. Halloran, A. F.
1944. History and present status of bighorn on south central New Mexico. J. Mammal. 25:364-367.

116. Halloran, A. F.
1947. Bighorns on the border. Audubon Mag. 49:332-337.

117. Halloran, A. F.
1949. Desert bighorn management. North Am. Wildl. Nat. Resour. Conf. Trans. 14:527-537.

118. Halloran, A. F.
1954. Carnivores of Yuma County, Arizona. Am. Midl. Nat. 51:481-487.

119. Halloran, A. F.
1957. A note on the Sonoran pronghorn. J. Mammal. 38:423

120. Halloran, A. F., and W. E. Blanchard.
1950. Bighorn ewe associated with cattle on Kofa Game Range, Arizona. J. Mammal. 31:463.

121. Halloran, A. F., and H. B. Crandell.
1953. Notes on bighorn food in the Sonoran zone. J. Wildl. Manage. 17:318-320.

122. Halloran, A. F., and O. V. Deming.
1956. Water developments for desert bighorn sheep. U.S. Fish and Wildl. Serv. Wildl. Manage. Ser. Leafl. 14, 12 p.

123. Halloran, A. F., and C. A. Kennedy.
1949. Bighorn-deer food relationships in southern New Mexico. J. Wildl. Manage. 13:417-419.

124. Hanson, H. C.
1924. A study of the vegetation of northeastern Arizona. Univ. of Nebr., Univ. Studies 24(3-4):85-178.

125. Hanson, W. R., and C. Y. McCulloch.
1955. Factors influencing mule deer on Arizona brushlands. North Am. Wildl. Nat. Resour. Conf. Trans. 20:568-588.

126. Harris, B. K.
1960. Quail trend counts as a management tool. 40th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 200-204.

127. Hass, A.
1967. Hunter's guide to the elk of New Mexico. N. Mex. Dep. Game and Fish. 2nd ed. 16 p.

128. Hastings, J. R., R. M. Turner, and D. K. Warren.
1972. An atlas of some plant distributions in the Sonoran Desert. Univ. of Ariz. Tech. Rep. Meteorol. Clim. Arid Regions, 21:1-255.

129. Heidman, L. J.
1963. Deer repellents are effective on ponderosa pine in the Southwest. J. For. 61:53-54.

130. Hensley, M. M.
1954. Ecological relationships of the breeding bird population of the desert biome in Arizona. Ecol. Monogr. 24:185-207.

131. Hibbert, A. R., E. A. Davis, and D. G. Scholl.
1974. Chaparral conversion potential in Arizona, Part I: water yield response and effects on other resources. USDA For. Serv. Res. Pap. RM-126, 36 p.

132. Hodgin, F. N.
1957. Deer and habitat management on the Kaibab National Forest. 37th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 221-222.

133. Hoffmeister, D. F.
1962. The kinds of deer, Odocoileus in Arizona. Am. Midl. Nat. 67:45-64.

134. Hoffmeister, D. F., and S. W. Carothers.
1969. Mammals of Flagstaff, Arizona. Plateau 41:184-188.

135. Hoffmeister, D. F., and W. W. Goodpaster.
1954. The mammals of the Huachuca Mountains, southeastern Arizona. Biol. Monogr. 24:1-152.

136. Hubbard, J. P.
1965. The summer birds of the forests of the Mogollon Mountains, New Mexico. Condor 67:404-415.

137. Hubbard, J. P.
1971. The summer birds of the Gila Valley, New Mexico. Del. Mus. Nat. Hist. Occas. Pap. 2:5-11, 28-30.

138. Hubbard, J. P.
1974. The biota of the Pinos Altos Mountains, southwestern New Mexico, a preliminary report. Del. Mus. Nat. Hist., 11 p.

139. Humphrey, R. R.
1958. The desert grassland; a history of vegetational change and an analysis of causes. Bot. Rev. 24:193-252.

140. Hungerford, C. R.
1955. A preliminary evaluation of quail malaria in southern Arizona in relation to habitat and quail mortality. North Am. Wildl. and Nat. Resour. Conf. Trans. 20:209-219.

141. Hungerford, C. R.
1960. The factors affecting breeding of Gambel's quail (Lophortyx gambelii gambelii) in Arizona. Ph.D. Diss., Univ. of Ariz., Tucson, 94 p.

142. Hungerford, C. R.
1960. Water requirements of Gambel's quail. North Am. Wildl. and Nat. Resour. Conf. Trans. 25:231-240.

143. Hungerford, C. R.
1962. Adaptations shown in selection of food by Gambel quail. Condor 64:213-219.

144. Hungerford, C. R.
1964. Vitamin A and productivity in Gambel's quail. J. Wildl. Manage. 28:141-147.

145. Hungerford, C. R.
1965. Response of Kaibab mule deer to reseeded forest and meadow. North Am. Wildl. and Nat. Resour. Conf. Trans. 30:310-320.

146. Hungerford, C. R.
1970. Response of Kaibab mule deer to management of summer range. J. Wildl. Manage. 34:852-862.

I

147. Illige, D.
1952. Game range improvement procedures in Arizona. 32nd Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 141-143.

148. Illige, D.
1953. Productivity data of Arizona mule deer. 33nd Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 117-127.

149. Illige, D.
1954. The analyzation of deer specimens from various Arizona deer herds. Ariz. Game and Fish Comm. Compl. Rep., Wildl. Res. Div., 26 p.

150. Illige, D., and A. C. Edwards.
1951. Field-laboratory studies of mule deer reproduction in Arizona. 31st Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 195-198.

151. Ingles, L. G.
1941. Natural history observations on the Audubon cottontail. J. Mammal. 22(3):227-250.

152. Irby, H. D.
1964. The relationship of calling behavior to mourning dove populations and production in southern Arizona. Ph.D. Diss., Univ. of Ariz., Tucson, 100 p.

153. Irby, H. D., and L. H. Blankenship.
1966. Breeding behavior of immature mourning doves. J. Wildl. Manage. 30:598-604.

154. Ivey, R. D.
1957. Ecological notes on the mammals of Bernalillo County, New Mexico. J. Mammal. 38:490-502.

J

155. Jameson, D. A.
1967. The relationship of tree overstory and herbaceous understory vegetation. J. Range Manage. 20(4):247-249.

156. Jantzen, R. A.
1959. Research needs for Merriam turkey in Arizona. 1st Nat. Wild Turkey Manage. Symp. Proc. p. 183-191.

157. Jantzen, R. A.
1964. Population declines of mule deer in northern Arizona. 44th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 158-166.

158. Jantzen, R. A.
1966. Watershed management as it affects game management. Ariz. Watershed Symp. Proc. 10:18-20.

159. Johnson, A. R., and J. C. Barlow.
1971. Notes on the nesting of the black-bellied tree duck near Phoenix, Arizona. Southwest. Nat. 15(3):394-395.

160. Johnson, R. R.
1973. The effects of chaparral control on birds of the Mazatzals, Maricopa County, Arizona. Prescott Coll. Ecol. Surv., 10 p.

161. Jones, D. A.
1973. The role of prescribed fire in wildlife management. Ariz. Watershed Symp. Proc. 17:21-22.

162. Jones, J. R.
1971. An experiment in modeling Rocky Mountain forest ecosystems. USDA For. Serv. Res. Pap. RM-75, 19 p.

163. Jones, J. R.
1974. Silviculture of southwestern mixed conifers and aspen: the status of our knowledge. USDA For. Serv. Res. Pap. RM-122, 44 p.

164. Judd, B. I.
1972. Vegetation zones around a small pond in the White Mountains of Arizona. Great Basin Nat. 32:91-96.

165. Julander, O.
1937. Utilization of browse by wildlife. North Am. Wildl. and Nat. Resour. Conf. Trans. 2:276-287.

K

166. Kartchner, K. C.
1941. Desirability for control of predators in wildlife management as experienced in Arizona. North Am. Wildl. and Nat. Resour. Conf. Trans. 6:273-277.

167. Keith, J. O.
1965. The Abert squirrel and its dependence on ponderosa pine. Ecology 46:150-163.

168. Kennedy, C. A.
1948. Golden eagle kills bighorn lamb. J. Mammal. 29:68-69.

169. Kimball, T. L., and A. G. Watkins.
1951. The Kaibab north cooperative deer-livestock forage relationship study. Ariz. Game and Fish Comm., 77 p.

170. Kirkpatrick, R. D., and L. K. Sowls.
1962. Age determination of the collared peccary (*Pecari tajacu*) by the tooth replacement pattern. J. Wildl. Manage. 26:214-217.

171. Kirkpatrick, R. L., J. P. Fontenot, and R. F. Harlow.
1969. Seasonal changes in rumen chemical components as related to forages consumed by white-tailed deer of the Southwest. North Am. Wildl. Nat. Res. Conf. Trans. 34:229-238.

172. Kirkpatrick, T. O.
1965. The economic and social values of hunting and fishing in New Mexico. N. Mex. Dep. Game and Fish and Bur. Bus. Res. Rep., Univ. of N. Mex., 94 p.

173. Knipe, T.
1944. The status of the antelope herds of northern Arizona. Ariz. Game and Fish Comm., 40 p.

174. Knipe, T.
1957. The javelina in Arizona. Ariz. Game and Fish Comm. Wildl. Bull. 2, 96 p.

175. Knopp, T. B.
1959. Factors affecting the abundance and distribution of Merriam turkey, *Meleagris gallopavo merriami*. M.S. Thesis, Univ. of Ariz., Tucson, 58 p.

176. Krebill, R. G.
1972. Preliminary annotated list of diseases of shrubs on western game ranges. USDA For. Serv. Res. Note INT-156, 8 p.

177. Krochmal, A., S. Paur, and P. Duisberg.
1954. Useful native plants in the American southwestern deserts. Econ. Bot. 8:3-20.

178. Kruse, W. H.
1972. Effects of wildfire on elk and deer use of a ponderosa pine forest. USDA For. Serv. Res. Note RM-226, 4 p.

179. Kufeld, R. C.
1973. Foods eaten by the Rocky Mountain elk. J. Range Manage. 26(2):106-113.

180. Kufeld, R. C., O. C. Wallmo, and C. Feddema.
1973. Foods of the Rocky Mountain mule deer. USDA For. Serv. Res. Pap. RM-111, 31 p.

181. Kundaeli, J. N.
1969. Cottontail rabbit response to pinyon-juniper removal. M.S. Thesis, Colo. State Univ., Fort Collins, Colo. 57 p.

182. Kundaeli, J. N., and H. G. Reynolds.
1972. Desert cottontail use of natural and modified pinyon-juniper woodland. J. Range Manage. 25:116-118.

L

183. Lamb, S. H.
1964. Sagebrush and pinyon-juniper control as a game habitat improvement practice. Wildl. Soc., N. Mex.-Ariz. Sect. Proc. 3:29-36.

184. Lamb, S. H.
1971. Woody plants of New Mexico and their value to wildlife. N. Mex. Dep. Game and Fish Bull. 14, 80 p.

185. Lamb, S. H., and R. Pieper.
1971. Game range improvement in New Mexico. USDA Agric. Res. Serv., Las Cruces, N. Mex., N. Mex. Inter-Agency Range Comm. Rep. No. 9, 28 p.

186. Lang, E. M.
1957. Deer of New Mexico. N. Mex. Dep. Game and Fish Bull. 5, 41 p.

187. Lang, E. M.
1958. Elk of New Mexico. N. Mex. Dep. Game and Fish, 33 p.

188. Lange, K. I.
1960. Mammals of the Santa Catalina Mountains, Arizona. Am. Midl. Nat. 64:436-458.

189. Larson, M. M., and G. H. Schubert.
1970. Cone crops of ponderosa pine in central Arizona including the influence of Abert squirrel. USDA For. Serv. Res. Pap. RM-58, 15 p.

190. Lee, L.
1951. Results of a four-year quail malaria study in New Mexico. 31st Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 121-123.

191. Lee, L.
1963. New Mexico's exotic game program. 43rd Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 143-146.

192. Lee, L.
1967. Furbearers and predators of New Mexico. N. Mex. Dep. Game and Fish. 10 p.

193. Lee, M., and D. F. Hoffmeister.
1963. Status of certain fox squirrels in Mexico and Arizona. Biol. Soc. Wash. Proc. 76:181-190.

194. Leopold, A.
1924. Grass, brush, timber, and fire in southern Arizona. J. For. 22(6):1-10.

195. Leopold, A. S., and R. A. McCabe.
1957. Natural history of the Montezuma quail in Mexico. Condor 59:3-26.

196. Leopold, L. B.
1951. Vegetation of southwestern watersheds in the nineteenth century. Geogr. Rev. 41(2):295-316.

197. Ligon, J. S.
1927. Wildlife of New Mexico. N. Mex. Dep. Game and Fish 212 p.

198. Ligon, J. S.
1937. Tragedy of upland game birds throughout the West and Southwest. North Am. Wildl. and Nat. Resour. Conf. Trans. 2:476-480.

199. Ligon, J. S.
1938. Wildlife and modern land-use policies in the Southwest. Cattleman 26(6):45-48.

200. Ligon, J. S.
1946. Upland game bird restoration through trapping and transplanting. N. Mex. Game and Fish Comm. 77 p.

201. Ligon, J. S.
1946. History and management of Merriam's wild turkey. N. Mex. Dep. Game and Fish Comm. 84 p.

202. Ligon, J. D.
1968. Sexual differences in foraging behavior in two species of dendrocopos woodpeckers. Auk 85:203-215.

203. Ligon, J. D.
1971. Late summer-autumnal breeding of the pinon jay in New Mexico. Condor 73:147-153.

204. Little, E. L.
1950. Southwestern trees; a guide to the native species of New Mexico and Arizona. U.S. Dep. Agric. Agric. Handb. 41, 472 p.

205. Little, E. L., Jr.
1968. Southwestern trees, a guide to the native species of New Mexico and Arizona. U.S. Dep. Agric. Agric. Handb. 9, 109 p.

206. Lowe, C. H.
1961. Biotic communities in the sub-Mogollon region of the inland Southwest. J. Ariz. Acad. Sci. 2:40-49.

207. Lowe, C. H.
1964. Arizona's natural environment; landscapes and habitats. Univ. of Ariz. Press, Tucson, 136 p.

208. Lowe, C. H.
1964. The vertebrates of Arizona. Univ. of Ariz. Press, Tucson, 259 p.

209. Lowe, C. H., and D. E. Brown.
1973. The natural vegetation of Arizona. Arizona Resources Information System (ARIS), Coop. Publ. No. 2, 53 p.

M

210. MacArthur, R. H.
1964. Environmental factors affecting bird species diversity. Am. Nat. 98(903):387-397.

211. MacDonald, D.
1963. Trapping and marking Merriam's wild turkeys. 43rd Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 196-201.

212. MacMillen, R. E., and C. H. Trost.
1966. Water economy and salt balance in white-winged and Inca doves. Auk 83:441-456.

213. Maddox, G. E.
1972. Ecologic-economic values in phreatophyte control. p. 257-259 In Watersheds in Transition Symp. [Ft. Collins, Colo., June 1972] Proc. Ser. 14, 405 p. Am. Water Resour. Assoc., Urbana, Ill.

214. Marshall, J. T., Jr.
1962. Land use and native birds in Arizona. Ariz. Acad. Sci. J. 2(2):75-77.

215. Martin, W. E., R. L. Gum, and A. H. Smith.
1974. The demand for and value of hunting, fishing and general rural outdoor recreation in Arizona. Ariz. Agric. Exp. Stn. Tech. Bull. 221, 56 p.

216. Marshall, J. T., Jr.
1967. Birds of pine-oak woodland in southern Arizona and adjacent Mexico. Cooper Ornithol. Soc., Pac. Coast Avifauna, 32, 125 p.

217. McClellan, J.
1955. Preliminary report on the Barbary sheep of New Mexico. 35th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 167-176.

218. McCulloch, C. Y., Jr.
1955. Breeding record of javelina, Tayassu angulatus, in southern Arizona. J. Mammal. 36:146.

219. McCulloch, C. Y., Jr.
1955. Utilization of winter browse on wilderness big game range. J. Wildl. Manage. 19:206-215.

220. McCulloch, C. Y., Jr.
1959. Effects of rodents and rabbits on estimates of forage disappearance. Okla. Acad. Sci. Proc. 39:202-204.

221. McCulloch, C. Y., Jr.
1967. Recent records of white-tailed deer in northern Arizona. Southwest. Nat. 12:469-487.

222. McCulloch, C. Y., Jr.
1968. Transplanted mule deer in Arizona. J. Ariz. Acad. Sci. 5:43-44.

223. McCulloch, C. Y., Jr.
1969. Some effects of wildfire on deer habitat in pinyon-juniper woodland. J. Wildl. Manage. 33:778-784.

224. McCulloch, C. Y., Jr.
1962. Watershed and game management. Ariz. Watershed Symp. Proc. 6:25-27.

225. McCulloch, C. Y., Jr.
1972. Deer food and brush control in southern Arizona. J. Ariz. Acad. Sci. 7:113-119.

226. McCulloch, C. Y., Jr.
1973. Final report--Control of pinyon-juniper as a deer management measure in Arizona. Ariz. Fed. Aid Proj. Proj. No. W-78-R, 32 p.

227. McCulloch, C. Y., Jr.
1973. Seasonal diets of mule and white-tailed deer. In Deer nutrition in Arizona chaparral and desert habitats. Ariz. Game and Fish Dep., Res. Div., and USDA For. Serv., Rocky Mt. For. and Range Exp. Stn., Spec. Rep. 3, p. 1-37.

228. McCulloch, C. Y., Jr., O. C. Wallmo, and P. F. Ffolliott.
1965. Acorn yield of Gambel oak in northern Arizona. U.S. For. Serv. Res. Note RM-48, 2 p.

229. McKee, E. W.
1941. Distribution of the tassel-eared squirrels. Plateau 14:12-20.

230. McKnight, T. L.
1958. The feral burro in the United States: distribution and problems. J. Wildl. Manage. 22:163-179.

231. McMichael, T. J.
1964. Studies of the relationship between desert big-horn and feral burro in the Black Mountains of northwestern Arizona. M.S. Thesis, Univ. of Ariz., Tucson, 38 p.

232. Merkle, J.
1954. An analysis of the spruce-fir community on the Kaibab Plateau, Arizona. Ecology 35:316-322.

233. Merkle, J.
1962. Plant communities of the Grand Canyon area, Arizona. Ecology 43:698-711.

234. Mollhagen, R. T., R. W. Wiley, and R. L. Packard.
1972. Prey remains in golden eagle nests: Texas and New Mexico. J. Wildl. Manage. 36:784-792.

235. Monson, G.
1941. The effect of revegetation on small bird populations in Arizona. J. Wildl. Manage. 5:396-397.

236. Monson, G.
1973. Unique birds and mammals of the Coronado National Forest. USDA For. Serv., typewritten, on file, Supervisor's Office, Tucson, Ariz. 78 p.

237. Moore, T. C.
1965. Origin and disjunction of the alpine tundra flora on San Francisco Mountain, Arizona. Ecology 46:860-864.

238. Morrison, D.
1964. The new look in timber harvesting--possible effects on wildlife. Wildl. Soc., N. Mex.-Ariz. Sec. Proc. 3:75-79.

239. Murie, A.
1946. The Merriam turkey on the San Carlos Indian Reservation. J. Wildl. Manage. 10:329-333.

N

240. Neal, B. J.
1959. A contribution on the life history of the collared peccary in Arizona. Am. Midl. Nat. 6:177-190.

241. Neal, B. J.
1959. Techniques of trapping and tagging the collared peccary. J. Wildl. Manage. 23:1-16.

242. Neal, B. J., and R. D. Kirkpatrick.
1957. Anomalous canine tooth development in the Arizona peccary. J. Mammal. 38:420.

243. Neff, D. J.
1968. The pellet-group count technique for big game trend, census, and distribution: a review. J. Wildl. Manage. 32:597-614.

244. Neff, D. J.
1972. Responses of deer and elk to Beaver Creek Watershed treatments. Ariz. Watershed Symp. Proc. 16:18-24.

245. Neff, D. J.
1974. Forage preferences of trained mule deer on the Beaver Creek Watersheds. Ariz. Game and Fish Dep . Res. Div., Spec. Rep. 4, 61 p.

246. Neff, D. J., O. C. Wallmo, and C. C. Morrison.
1965. A determination of defecation rate for elk. J. Wildl. Manage. 29:406-407.

247. Neff, J. A.
1940. Notes on nesting and other habits of the western white-winged dove in Arizona. J. Wildl. Manage. 4:279-290.

248. Neff, J. A.
1940. Range, population, and game status of the western white-winged dove in Arizona. J. Wildl. Manage. 4:117-127.

249. Neff, J. A.
1947. Habits, food, and economic status of the band-tailed pigeon. USDI Fish and Wildl. Serv., North Am. Fauna, 58, 76 p.

250. New Mexico Department of Game and Fish.
1967. New Mexico wildlife management. Santa Fe, 250 p.

251. Nichol, A. A.
1938. Experimental feeding of deer. Ariz. Agric. Exp. Stn. Tech. Bull. 75:1-39.

252. Nichol, A. A.
1942. Gathering, transplanting, and care of young antelope. J. Wildl. Manage. 6:281-286.

253. Nichol, A. A.
1952. The natural vegetation of Arizona. Ariz. Agric. Exp. Stn. Tech. Bull. 127:188-191.

254. Nickerson, M. F., and G. E. Brink
1974. Publications of the Rocky Mountain Forest and Range Experiment Station 1953-73. USDA For. Serv. Gen. Tech. Rep. RM-6, 96 p.

255. Norris, J. J.
1950. Effect of rodents, rabbits, and cattle on two vegetation types in semi-desert range land. N. Mex. Agric. Exp. Stn. Bull. 353, 23 p.

O

256. O'Connell, P. F.
1972. Economics of chaparral management in the Southwest. p. 260-266. In Watersheds in Transition Symp. [Ft. Collins, Colo., June 1972] Proc. Ser. 14, 405 p. Am. Water Resour. Assoc., Urbana, Ill.

257. Ogren, H. A.
1962. The barbary sheep, *Ammotragus lervia* (Pallas), of the Canadian River Gorge, New Mexico. Ph.D. Diss., Univ. of South. Calif., Los Angeles, 256 p.

258. Ogren, H. A.
1962. Barbary sheep in New Mexico. N. Mex. Dep. Game and Fish, 32 p.

259. Olin, G.
1954. Animals of the southwestern deserts. S.W. Monuments Assoc. Pop. Ser. 8, p. 1-112.

P

260. Pase, C. P.
1966. Grazing and watershed values of native plants. p. 31-40. In Native plants and animals as resources in arid lands of the southwestern United States. Am. Assoc. Adv. Sci., Rocky Mt. Southwest. Div. [Comm. Desert Arid Zones Res., Flagstaff, Ariz., May 1965] Contrib. 8:31-40.

261. Pase, C. P., P. A. Ingebo, E. A. Davis, and C. Y. McCulloch.
1967. Improving water yield and game habitat by chemical control of chaparral. XIV Int. Union For. Res. Organ. Congr. [Munich, Sept. 1967] Proc. v. I., Sect. 01-02-11, p. 463-486.

262. Patton, D. R.
1969. Deer and elk use of a ponderosa pine forest in Arizona before and after timber harvest. USDA For. Serv. Res. Note RM-139, 7 p.

263. Patton, D. R., and H. D. Avant.
1970. Fire stimulated aspen sprouting in a spruce-fir forest in New Mexico. USDA For. Serv. Res. Note RM-159, 3 p.

264. Patton, D. R., and W. B. Casner.
1970. Port-a-punch recording and computer summarization of pellet count data. USDA For. Serv. Res. Note RM-170, 7 p.

265. Patton, D. R.
1974. Characteristics of ponderosa pine stands selected by the Abert's squirrel for cover. Ph.D. Diss., Univ. of Ariz., Tucson, 40 p.

266. Patton, D. R.
1974. Patch cutting increases deer and elk use of a pine forest in Arizona. J. For. 72:764-766.

267. Patton, D. R., and W. Green.
1970. Abert's squirrels prefer mature ponderosa pine. USDA For. Serv. Res. Note RM-169, 3 p.

268. Patton, D. R., and J. M. Hall.
1966. Evaluating key areas by browse and form class. J. Wildl. Manage. 30:476-480.

269. Patton, D. R., and B. I. Judd.
1970. The role of wet meadows as wildlife habitat in the Southwest. J. Range Manage. 23:272-275.

270. Patton, D. R.
1974. Estimating food consumption from twigs clipped by the Abert squirrel. USDA For. Serv. Res. Note RM-272, 3 p.

271. Patton, D. R.
1975. Nest use and home range of three Abert squirrels as determined by radio tracking. USDA For. Serv. Res. Note RM-281, 3 p.

272. Pearson, G. A.
1931. Forest types in the Southwest as determined by climate and soil. U.S. Dep. Agric. Tech. Bull. 247, 143 p.

273. Pearson, H. A.
1968. Thinning, clearcutting, and reseeding affect deer and elk use of ponderosa pine forests in northern Arizona. U.S. For. Serv. Res. Note RM-119, 4 p.

274. Pearson, H. A.
1969. Rumen microbial ecology in mule deer. Appl. Microbiol. 17:819-824.

275. Pearson, H. A.
1969. Starvation in antelope with stomachs full of feed. USDA For. Serv. Res. Note RM-148, 4 p.

276. Powell, L. E., J. P. Russo, G. I. Day, and R. A. Jantzen.
1956. Game habitat improvement recommendations. Ariz. Game and Fish Dep., Job Compl. Rep. Fed. Aid Proj. W-53-R-6, 6 p.

R

277. Raitt, R. J., and R. D. Ohmart.
1966. Annual cycle of reproduction and molt in Gambel quail of the Rio Grande Valley, southern New Mexico. Condor 68:541-561.

278. Raitt, R. J., and R. D. Ohmart.
1968. Sex and age ratios in Gambel quail of the Rio Grande Valley, southern New Mexico. Southwest. Nat. 13:27-33.

279. Rasmussen, D. I.
1941. The biotic communities of the Kaibab Plateau, Arizona. Ecol. Monogr. 11:229-275.

280. Ratcliff, T. D.
1974. Kaibab squirrel activities in relation to forest characteristics. M.S. Thesis, Univ. of Ariz., Tucson, 39 p.

281. Ratcliff, T. D., D. R. Patton, and P. F. Ffolliott.
1975. Ponderosa pine basal area and the Kaibab squirrel. J. For. 73(5):284-286.

282. Reynolds, H. G.
1957. Porcupine behavior in the desert-shrub type of Arizona. J. Mammal. 38:418-419.

283. Reynolds, H. G.
1962. Arizona's population growth and its effects on native plants and animals: a symposium. Part 2--Some characteristics and use of Arizona's major plant communities. J. Ariz. Acad. Sci. 2:62-71.

284. Reynolds, H. G.
1962. Effect of logging on understory vegetation and deer use in a ponderosa pine forest of Arizona. U.S. Dep. Agric., For. Serv., Rocky Mt. For. and Range Exp. Stn. Res. Note 80, 7 p.

285. Reynolds, H. G.
1974. Habitat research--cornerstone in management. N.M. Wildl. 19(1):28-30.

286. Reynolds, H. G.
1962. Use of natural openings in a ponderosa pine forest of Arizona by deer, elk, and cattle. U.S. Dep. Agric., For. Serv., Rocky Mt. For. and Range Exp. Stn. Res. Note 78, 4 p.

287. Reynolds, H. G.
1963. A wildlife habitat research program for the Southwest. Ariz.-N.M. Wildl. Soc. [Glenwood, N.M., Feb. 1963] Proc. 2:28-40.

288. Reynolds, H. G.
1963. Western goshawk takes Abert squirrel in Arizona. J. For. 61:839.

289. Reynolds, H. G.
1964. Elk and deer habitat use of a pinyon-juniper woodland in southern New Mexico. North Am. Wildl. Nat. Resour. Conf. Trans. 29:438-444.

290. Reynolds, H. G.
1965. Mule deer killed by lightening. J. Mammal. 46:676.

291. Reynolds, H. G.
1964. Some livestock-wildlife habitat relations in Arizona and New Mexico. Am. Soc. Range Manage., N. Mex. Sect. [Albuquerque, N. Mex., Dec. 1964] Proc. 1964, 13 p.

292. Reynolds, H. G.
1966. Abert's squirrels feeding in pinyon pine. J. Mammal. 47:550-551.

293. Reynolds, H. G.
1966. Slash cleanup in ponderosa pine forest affects use by deer and cattle. U. S. For. Serv. Res. Note RM-64, 3 p.

294. Reynolds, H. G.
1966. Some wildlife habitat management implications from research in Arizona and New Mexico. Am. Soc. Range Manage. [New Orleans, La., Feb. 1966] Abstr. of Pap. 19:30.

295. Reynolds, H. G.
1966. Use of a ponderosa pine forest in Arizona by deer, elk, and cattle. U. S. For. Serv. Res. Note RM-63, 7 p.

296. Reynolds, H. G.
1966. Use of openings in spruce-fir forests of Arizona by elk, deer, and cattle. U.S. For. Serv. Res. Note RM-66, 4 p.

297. Reynolds, H. G.
1967. Chemical constituents and deer use of some crown sprouts in Arizona chaparral. J. For. 65:905-908.

298. Reynolds, H. B.
1969. Aspen grove use by deer, elk, and cattle in southwestern coniferous forests. USDA For. Serv. Res. Note RM-138, 4 p.

299. Reynolds, H. G.
1969. Improvement of deer habitat on southwestern forest lands. J. For. 67:803-805.

300. Reynolds, H. G.
1972. Wildlife habitat improvement in relation to watershed management in the Southwest. p. 10-17. In 16th Annu. Ariz. Watershed Symp. [Phoenix, Ariz., Sept. 1972] Proc. Ariz. Water Comm. Rep. 2, 43 p. Phoenix, Ariz.

301. Reynolds, H. G., and R. R. Johnson.
1964. Habitat relations of vertebrates of the Sierra Ancha Experimental Forest. U.S. For. Serv. Res. Pap. RM-4, 16 p.

302. Reynolds, H. G., and H. A. Paulsen, Jr.
1970. Range ecology in the western United States. p. 199-206. In Range and wildlife habitat evaluation--a research symposium. U.S. Dep. Agric. Misc. Publ. 1147, 220 p.

303. Reynolds, H. G., and A. W. Sampson.
1943. Chaparral crown sprouts as browse for deer. J. Wildl. Manage. 7:119-122.

304. Reynolds, H. G., W. P. Clary, and P. F. Ffolliott.
1970. Gambel oak for southwestern wildlife. J. For. 68:545-547.

305. Rich, L. R., and J. R. Thompson.
1974. Watershed management in Arizona's mixed conifer forests: The status of our knowledge. USDA For. Serv. Res. Pap. RM-130, 15 p.

306. Russell, T. P.
1964. Antelope of New Mexico. N. Mex. Dep. Game and Fish Bull. 12, 103 p.

307. Russo, J. P.
1956. The desert bighorn sheep in Arizona. Ariz. Game and Fish Dep. Fed. Aid Proj., 153 p.

308. Russo, J. P.
1958. Kaibab turkey transplant. 38th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 175-178.

309. Russo, J. P.
1964. The Kaibab North deer herd--its history, problems and management. Ariz. Game and Fish Dep. Wildl. Bull. 4, 196 p.

310. Russo, J. P.
1965. Hunting, a key to research studies of Arizona bighorn. 34th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 196-200.

S

311. Samson, K. S., and B. R. Donaldson.
1968. Parasites of the javelina in New Mexico. Bull. Wildl. Dis. Assoc. 4:131.

312. Schadle, D. P.
1960. Arizona's rainwater catchment. 40th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 163-167.

313. Schubert, G. H.
1974. Silviculture of southwestern ponderosa pine: The status of our knowledge. USDA For. Serv. Res. Pap. RM-123, 71 p.

314. Schweinsburg, R. E.
1969. Social behavior of the collared peccary (Pecari tajacu) in the Tucson Mountains. Ph.D. Diss., Univ. of Ariz., Tucson, 129 p.

315. Schweinsburg, R. E.
1971. Home range, movements, and herd integrity of the collared peccary. J. Wildl. Manage. 35:455-460.

316. Scott, V. E., and E. L. Boeker.
1972. An evaluation of wild turkey calls in Arizona. J. Wildl. Manage. 36:628-630.

317. Scott, V. E., and E. L. Boeker.
1975. Ecology of Merriam's wild turkey on the Fort Apache Indian Reservation. Third Natl. Turkey Symp. [San Antonio, Tex., Feb. 1975.] (In Press)

318. Senteney, P.
1958. Factors affecting the nesting of Gambel quail in southern Arizona. M.S. Thesis, Univ. of Ariz., Tucson, 42 p.

319. Shaw, H., and J. Jett.
1959. Mourning dove and white-winged dove nesting in the Gila River bottom between Gillespie Dam and the junction of the Salt and Gila Rivers, Maricopa County, Arizona. Ariz. Game and Fish Dep. Spec. Rep., Proj. W-53-R-10, WP 3, Job 2, 10 p.

320. Shields, L. M., and L. J. Gardner.
1961. Bioecology of the arid and semiarid lands of the Southwest. N. Mex. Highlands Univ. Bull. 212, 69 p. 34th Ann. Meet. Southwest. and Rocky Mt. Div. Am. Assoc. Adv. Sci., and N. Mex. Acad. Sci.

321. Shreve, F.
1942. Vegetation of Arizona. Flowering plants and ferns of Arizona. U.S. Dep. Agric. Misc. Publ. 423, p. 10-23.

322. Sileo, L., Jr., and E. L. Fitzbaugh.
1969. Incidence of trichomoniasis in the band-tailed pigeons of southern Arizona. Bull. Wildl. Dis. Assoc. 5(3):146.

323. Simmons, N. M.
1966. Observations of mammals in the Cabeza Prieta Game Range area, Arizona. J. Mammal. 47:122.

324. Simmons, N. M.
1969. The social organization, behavior, and environment of the desert bighorn sheep on the Cabeza Prieta Game Range, Arizona. Ph.D. Diss., Univ. of Ariz., Tucson, 169 p.

325. Simmons, N. M., and J. L. Phillips.
1966. Modifications of dye-spraying device for marking desert bighorn sheep. J. Wildl. Manage. 30:208-209.

326. Simmons, N. M., S. Levy, and J. Levy.
1963. Observation of desert sheep lambing, Kofa Game Range, Arizona. J. Mammal. 44:433.

327. Smith, R. H.
1961. Age classification of the Chukar partridge. J. Wildl. Manage. 25:84-86.

328. Smith, R. H.
1968. A comparison of several sizes of circular plots for estimating deer pellet-group density. J. Wildl. Manage. 32:585-591.

329. Smith, R. H.
1970. An accurate aging method for elk. Ariz. Game and Fish Dep., Wildl. Dig., Res. Abstr. 5, 4 p.

330. Smith, R. H., and S. Gallizioli.
1965. Predicting hunter success by means of a spring call count of Gambel quail. J. Wildl. Manage. 29:806-813.

331. Smith, R. H., and R. W. Davis.
1968. Blood parasite causes elk blindness. Wildl. Dig., Abstr. 1, 2 p.

332. Smith, R. H., T. J. McMichael, and H. G. Shaw.
1969. Decline of a desert deer population. Ariz. Game and Fish Dep., Wildl. Dig., Res. Abstr. 3, 8 p.

333. Smith, R. H., D. J. Neff, and C. Y. McCulloch.
1969. A model for the installation and use of a deer pellet group survey. Ariz. Game and Fish Dep., Res. Div., Spec. Rep. 1, 30 p.

334. Sowls, L. K.
1956. Wildlife conservation through cooperation. Ariz. Coop. Wildl. Res. Unit, Univ. of Ariz. Press, 32 p.

335. Sowls, L. K.
1957. Reproduction in the Audubon cottontail in Arizona. J. Mammal. 38:234-243.

336. Sowls, L. K.
1960. Results of a banding study of Gambel's quail in southern Arizona. J. Wildl. Manage. 24:185-190.

337. Sowls, L. K.
1961. Gestation period of the collared peccary. J. Mammal. 42:425-426.

338. Sowls, L. K.
1961. Hunter checking stations for collecting data on the collared peccary (*Pecari tajacu*). North Am. Wildl. Nat. Resour. Conf. Trans. 26:496-505.

339. Sowls, L. K.
1965. Reproduction in the collared peccary, (*Tayassu pecari*). (Abstr.) J. Reprod. and Fert. 9:371-372.

340. Sowls, L. K., and L. A. Greenwalt.
1956. Large traps for catching quail. J. Wildl. Manage. 20:84-86.

341. Sowls, L. K., and P. S. Minnamon.
1963. Glass beads for marking home ranges of mammals. J. Wildl. Manage. 27:299-302.

342. Sowls, L. K., V. R. Smith, R. Jenness; and E. Regehr.
1961. Chemical composition and physical properties of the milk of the collared peccary. J. Mammal. 42:245-251.

343. Spencer, D. A.
1941. A small mammal community in the upper Sonoran desert. Ecology 23:421-425.

344. Spencer, J. S.
1966. Arizona's forests. U.S. For. Serv. Resour. Bull., INT-6, 55 p.

345. Spicer, R. L.
1957. Emigration in Merriam's turkey. 37th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 230-233.

346. Spicer, R. L.
1959. Wild turkey in New Mexico. N. Mex. Dep. Game and Fish Bull. 10, 64 p.

347. Stair, J. L.
1958. Dove management and what it means to Arizona. 38th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 194-196.

348. Stephenson, R. L.
1975. Reproductive biology and food habits of Abert's squirrels in central Arizona. M.S. Thesis, Ariz. State Univ., 66 p.

349. Stout, G. G.
1970. The breeding biology of the desert cottontail in the Phoenix region, Arizona. J. Wildl. Manage. 34:47-51.

350. Swank, W. G.
1952. Trapping and marking of adult nesting doves. J. Wildl. Manage. 16:87-90.

351. Swank, W. G.
1954. The influence of hunting and of rainfall upon Gambel's quail populations. North Am. Wildl. and Nat. Resour. Conf. Trans. 19:283-295.

352. Swank, W. G.
1955. Bull only versus hunter's choice, a history of elk management in Arizona. 35th Ann. Conf. West. Assoc. State Fish and Game Comm. Proc. p. 155-161.

353. Swank, W. G.
1955. Feather molt as an aging technique for mourning doves. J. Wildl. Manage. 19:412-414.

354. Swank, W. G.
1956. Protein and phosphorus content of browse plants as an influence on southwestern deer herd levels. North Am. Wildl. and Nat. Resour. Conf. Trans. 21:141-158.

355. Swank, W. G.
1958. The mule deer in Arizona chaparral and an analysis of other important deer herds. Ariz. Game and Fish Dep. Wildl. Bull. 3, 109 p.

356. Swank, W. G.
1962. Manipulation of hunting regulations as a management measure. J. For. 60:30-32.

357. Swank, W. G., and S. Gallizioli.
1953. The effect of hunting upon a Gambel's quail population. 33rd Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 167-171.

T

358. Taylor, W. P.
1935. Ecology and life history of the porcupine (Erethizon epixanthum) as related to the forests of Arizona and the southwestern United States. Univ. of Ariz. Biol. Sci. Bull. 3, 177 p.

359. Taylor, W. P.
1936. The pronghorned antelope in the Southwest. North Am. Wildl. and Nat. Resour. Conf. Trans. 1:653-655.

360. Trefethen, J. B.
1967. The terrible lesson of the Kaibab. Nat. Wildl. 5(4):4-8.

361. Turkowski, F. J.
1969. Food habits and behavior of the gray fox, Urocyon cineorangenteus, in the lower and upper Sonoran life zones of southwestern United States. Ph.D. Diss., Ariz. State Univ., Tempe, 136 p.

U

362. U.S. Department of Interior.
1964. Natural resources of New Mexico. U.S. Gov't. Print. Off., Wash., D.C., 67 p.

363. U.S. Department of Interior.
1963. Natural resources of Arizona. U.S. Gov't. Print. Off., Wash., D.C., 52 p.

364. Urness, P. J.
1969. Nutrition analysis and in vitro digestibility of mistletoe browse by deer in Arizona. J. Wildl. Manage. 33:499-505.

365. Urness, P. J.
1973. Chemical analyses and in vitro digestibility of seasonal deer forages. In Deer nutrition in Arizona chaparral and desert habitats. Ariz. Game and Fish Dep., Res. Div., and USDA For. Serv., Rocky Mt. For. and Range Exp. Stn. Spec. Rep. 3, 39-52.

366. Urness, P. J.
1974. Deer use changes after root plowing in Arizona chaparral. USDA For. Serv. Res. Note RM-255, 8 p.

367. Urness, P. J., and C. Y. McCulloch.
1973. Nutritional value of seasonal deer diets. In Deer nutrition in Arizona chaparral and desert habitats. Ariz. Game and Fish Dep., Res. Div., and USDA For. Serv., Rocky Mt. For. and Range Exp. Stn. Spec. Rep. 3, 53-68.

368. Urness, P. J., W. Green, and R. K. Watkins.
1971. Nutrient intake of deer in Arizona chaparral and desert habitats. J. Wildl. Manage. 35:469-475.

V

369. Viers, C. E., Jr.
1970. The relationship of calling behavior of white-winged doves to population and production in southern Arizona. Ph.D. Diss., Univ. of Ariz., Tucson, 57 p.

370. Vorhies, C. T.
1946. Water requirements of desert animals in the Southwest. Univ. of Ariz. Agric. Exp. Stn. Tech. Bull. 107, p. 487-525.

W

371. Wallmo, O. C.
1954. Nesting of Mearns quail in southeastern Arizona. Condor 56:125-128.

372. Wallmo, O. C.
1955. Vegetation of the Huachuca Mountains, Arizona. Am. Midl. Nat. 54:466-480.

373. Wallmo, O. C., and S. Gallizioli.
1954. Status of the Coati in Arizona. J. Mammal. 35:48-54.

374. Wallmo, O. C.
1975. Important game animals and related recreation in arid shrublands of the United States. Third Workshop U.S./Aust. Rangelands Panel [Tucson, Ariz., Mar.-Apr., 1973] Proc., p. 98-107.

375. Watson, J. R.
1912. Plant geography of north central New Mexico. Bot. Gaz. 54:194-217.

376. Webb, P. M.
1960. Turkey trapping and transplanting in Arizona. 40th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 185-187.

377. Welch, J. M.
1960. A study of seasonal movements of white-tailed deer, *Odocoileus virginianus couesi*, in the Cave Creek Basin of the Chiricahua Mountains. M.S. Thesis., Univ. of Ariz., Tucson, 79 p.

378. Welch, J. M.
1960. Carrying capacity of various vegetation types for white-tailed deer. Ariz. Game and Fish Dep., Proj. W-78-R-4, WP5, J6, 31 p. (mimeo)

379. West, N. E., and M. M. Baasher.
1968. Determination of adequate plot size by use of mean distance between salt desert shrubs. Southwest. Nat. 13:61-74.

380. White, R. W.
1957. An evaluation of the white-tailed deer, *Odocoileus virginianus couesi*, habitats and foods in southern Arizona. M.S. Thesis, Univ. of Ariz., Tucson, 60 p.

381. White, R. W.
1958. Elk survey systems. 38th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 227-230.

382. White, R. W.
1961. Some foods of the white-tailed deer in southern Arizona. J. Wildl. Manage. 24:404-409.

383. Wilson, G. I.
1969. Some parasites of elk in New Mexico. Bull. Wildl. Dis. Assoc. 5:23-24.

384. Wigal, D. D.
1973. A survey of the nesting habitats of the white-winged dove in Arizona. Ariz. Game and Fish Dep., Res. Div., Spec. Rep. 2, 37 p.

385. Woodin, H. E., and A. A. Lindsey.
1954. Juniper-pinyon east of the Continental Divide, as analyzed by the linestrip method. Ecology 35:473-489.

386. Woods, L. G.
1966. Increasing watershed yield through management. J. Soil Water Conserv. 21(3):95-97.

387. Worley, D. P.
1965. The Beaver Creek pilot watershed for evaluating multiple-use effects of watershed treatments. U.S. For. Serv. Res. Pap. RM-13, 12 p.

388. Wright, J. T.
1949. Methods used in the Kaibab North livestock-deer forage relationships studies. 29th Ann. Conf. West. Assoc. State Game and Fish Comm. Proc. p. 129-134.

389. Wright, J. T.
1959. Desert wildlife. Ariz. Game and Fish Dep., Wildl. Bull. 6, 78 p.

390. Zyznar, E., and P. J. Urness.
1969. Qualitative identification of forage remnants in deer feces. J. Wildl. Manage. 32:506-510.

Supplement

(Publications not listed in the subject index)

Anderson, A. E.
1956. Unusual behavior of a golden eagle in southwestern New Mexico. Auk 73(4):287.

Anderson, A. E.
1962. A possible case of urinary calculi in a mule deer fawn. J. Mammal. 43(2):268-269.

Axelton, E. A.
1974. Ponderosa pine bibliography II. USDA For. Serv. Gen. Tech. Rep., INT-12, 63 p.

Carothers, S. W., J. R. Haldeman, and R. P. Balda.
1973. Breeding birds of the San Francisco Mountain area and the White Mountains, Arizona. Mus. of North. Ariz. Tech. Ser. 12. 54 p.

Guse, N. G., Jr.
1974. Colorado river bighorn sheep survey. Plateau 46(4):135-138.

Hoffmeister, D. F., and F. E. Durham.
1971. Mammals of the Arizona strip including Grand Canyon National Monument. Mus. of Nat. Hist., Univ. of Ill., Tech. Ser. 11:1-44.

Ligon, J. S.
1961. New Mexico birds and where to find them. Univ. of N. Mex. Press, Albuquerque. 360 p.

Wood, J. E., T. E. Bickle, W. Evans, J. C. Germany, and V. W. Howard Jr.
1970. The Fort Stanton mule deer herd. (Some ecological and life history characteristics with special emphasis on the use of water). N. Mex. State Univ., Agric. Exp. Stn., Bull. 567. 32 p.

Agriculture—CSU, Ft. Collins

Patton, David R., and Peter F. Ffolliott.
1975. Selected bibliography of wildlife and
habitats for the Southwest. USDA For. Serv.
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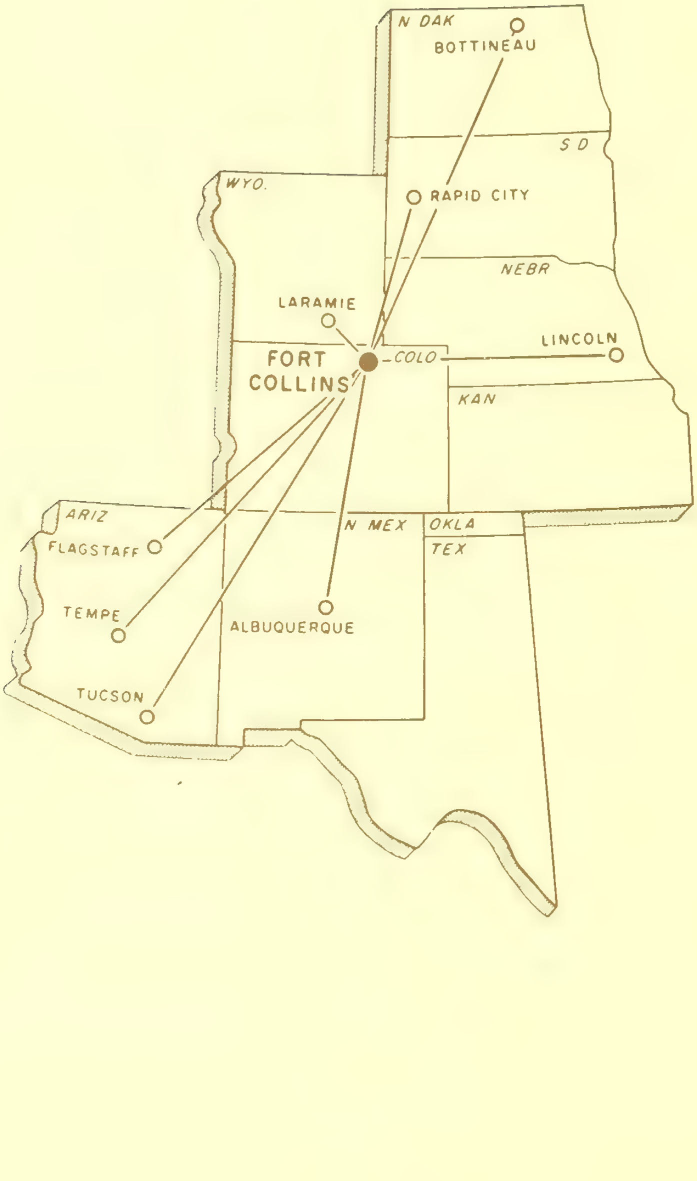
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An Aid to Streamlining Fire-Weather Station Networks

USDA Forest Service
General Technical Report RM-17

September 1975

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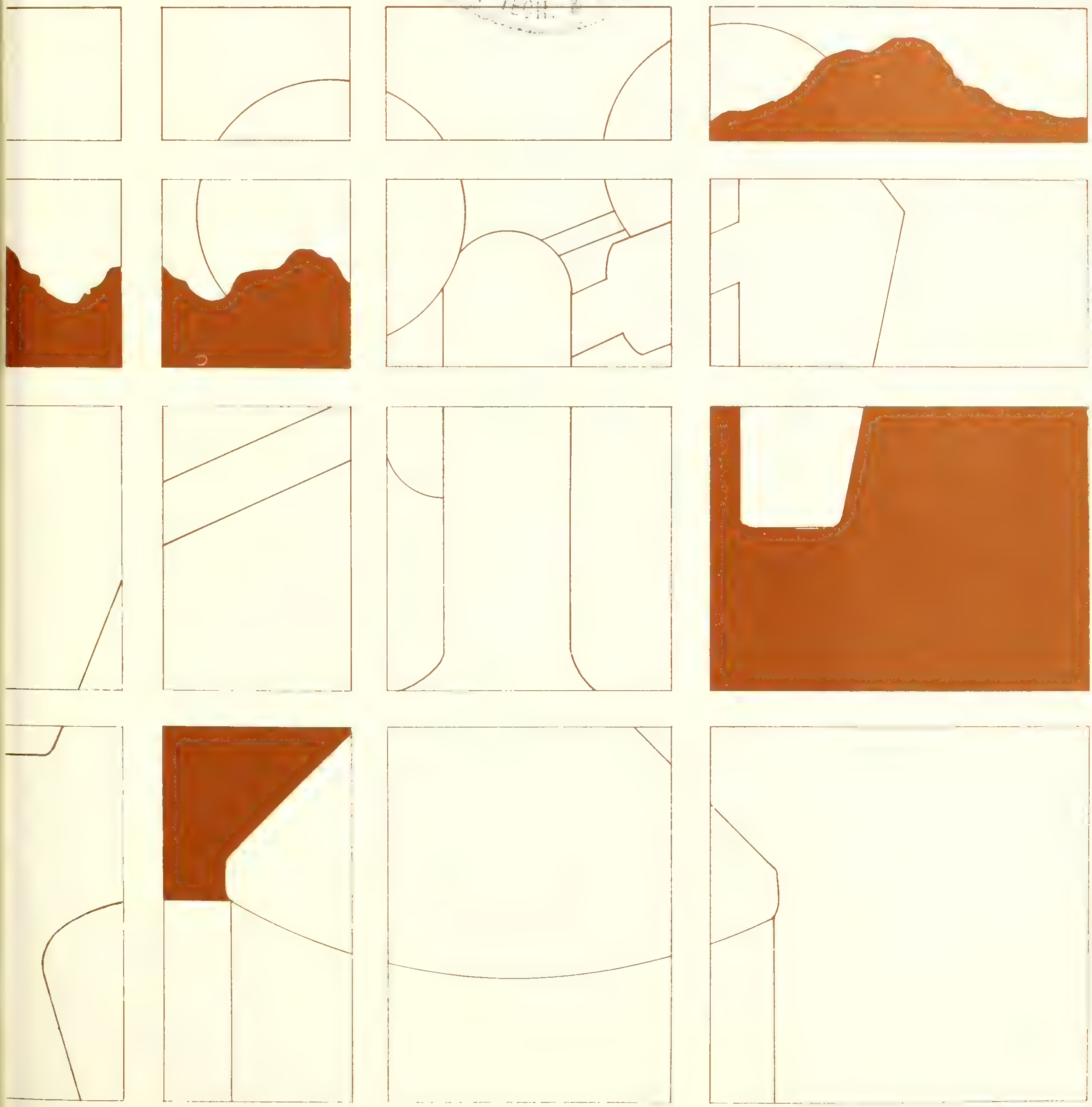

Abstract

Furman, R. William.
1975. An aid to streamlining fire-weather station networks. USDA For. Serv. Gen. Tech. Rep. RM-17, 4 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521

For reasons of economy it may be necessary to close one or several fire-weather stations in a protection area. Since it is logical to close those stations that will have the least impact on the ability of the fire manager to assess overall fire danger, it is desirable to know if there is duplication in monitoring fire climate, and to what degree. A method is proposed for determining this duplication, based on an analysis of six elements of fire climate. Stations are grouped on the basis of similarity of sequences of these fire climate elements over the fire season.

Keywords: Fire weather, National Fire Danger Rating System.

USDA Forest Service
General Technical Report RM-17

September 1975

An Aid to Streamlining Fire-Weather Station Networks

R. William Furman[1]

The Situation

The network of fire-weather stations which supports the National Fire Danger Rating System is changing continuously as new stations are added and existing stations are closed. Studies are currently underway to help the fire manager determine how many observation stations are necessary in his part of the country to adequately monitor the fire danger.

In the meantime, however, economic factors must be considered along with fire danger in determining the number of stations needed in a protection area. If it becomes necessary to reduce the number of observation sites on a protection unit, the task should be done in a manner that will minimize the impact on the ability of the fire manager to accurately assess the overall fire danger. A step toward this objective is to determine which stations monitor similar fire climates. Candidates for elimination may include those stations that duplicate effort.

Any reduction in the number of observation stations in an area will result in a decrease in the amount of information available to assess fire danger. Factors other than complete knowledge of fire danger must sometimes be considered, however. A method is needed that will provide guidance for deciding if—and where—there is duplication of effort in monitoring some components of fire weather. It is the intent of this paper to propose a technique to determine the location and degree of similarities of some elements of fire danger being monitored.

What is Fire Climate?

Fuel moisture content controls fuel ignition and strongly influences fire behavior. Moisture content is determined by the ambient and sometimes prior environmental temperature and humidity. Since ignition takes place in the fine fuels (1-hour timelag), and since fine fuels are common to all fuel models in the National Fire Danger Rating System, we will focus on the relationships between fire climate and the moisture content of the 1-hour timelag fuels. Although wind is a major weather input into NFDRS calculations, it is so variable that we did not include it in these similarity comparisons. It is a factor that would have to be considered, however, in any final decision to eliminate any stations.

The moisture content of fine fuels was related to their equilibrium moisture content (EMC) by Fosberg and Deeming (1971). The EMC is the moisture content a fuel particle will reach if left in constant environment for an infinitely long time. EMC has been related to temperature and humidity by Simard (1968). The moisture content of the smaller fuels reaches equilibrium with the environment very quickly. For this reason, it is not a bad first approximation to assume that the smaller fuels are constantly in equilibrium with their environment, and have a moisture content specified by the ambient temperature and humidity. Therefore, as a first effort at a quantitative definition of fire climate, we will consider the properties of the EMC.

The fire climate at a point is determined by an array of attributes. Properties of the fire climate at a site that should be measured include:

(1) An estimate of the mean value of the minimum (which normally occurs daily at 1400 hours).

(2) An estimate of the dispersion of the 1400h EMC about the mean. This is represented by the coefficient of variation, the ratio of the standard deviation to the mean.

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(3) The day-to-day persistence of EMC represented by the 1-day lag autocorrelation of the daily EMC's.

(4) An estimate of the mean diurnal variation of EMC. The diurnal variation was computed by subtracting the minimum EMC from the maximum EMC for a 24-hour period. These maximum and minimum EMC's can be computed from minimum temperatures and maximum relative humidities, and from maximum temperatures and minimum relative humidities, respectively.

(5) The coefficient of variation about the mean daily variation.

(6) The day-to-day persistence of the daily variation.

These six statistics of the EMC define fire climate. The first three are fairly good discriminators of aspect effects while the latter three tend to discriminate elevation effects (Furman 1974).

A Brief Resume of the Method

For completeness, a brief but technical description of the similarity analysis methodology is given. If the reader is not interested in the technical aspects, he may go to the next section for an example of how the method is used, and the results.

The analysis is performed for the fire season or a portion of it. So as not to eliminate any seasonal trend by averaging, the season is divided into consecutive 10-day periods. There is nothing special about intervals of 10 days; it is just a convenient period over which to sample the fire climate. If an observation is taken each day, the amount of data in each period is 10 days per year times the number of years of data. All six variables are then determined from the data in each of the periods, and collectively are considered as defining the fire climate. If a fire season were 40 days long, for example, then the number of variables for each station used in the analysis would be 6 per period times 4 periods equals 24 variables. Principal component analysis is then used to reduce this large number of variables to a few meaningful combinations.

Principal component analysis is a multivariable statistical method that can be used to express the original variation in terms of a few variables that are linear combinations of the original variables (Morrison 1967). The method has been used in many forestry applications such as taxonomic research (Jeffers 1966), site classification (Fourt et al. 1971), and climate regionalization as related to tree species distribution (Newnham 1968).

The new variables (or combinations) for each station are then used in a clustering program called ISODATA (Ball and Hall 1965), to group the stations into any desired number of clusters. The result is an arrangement of stations into groups or clusters with a minimum of variation among stations within each cluster, and a maximum amount of variation among clusters.

If constraints are such that the existing station network must be reduced by a certain number of stations, then the approach should be to minimize duplication by removing the stations which are most similar to others. These stations will show up as occupants of the same cluster. It makes little difference which station(s) in a cluster are eliminated.

As an indication of how the removal of a station or stations affects the accuracy of the observing network, we can compare the sums of squared deviations from the original sample means, before and after the removal of the station(s). As stations are removed from the sampling network, the ratio of these sums will decrease from one toward zero.

When the decision has been made as to which stations will be eliminated, the sums of squares ratio with those stations removed will indicate the extent to which the information received from the new network is reduced compared to the original. No criterion is available on what constitutes an optimum, acceptable, or maximum permissible level of reduction. This decision must be based on other factors.

An Example of Station Similarity Analysis: The Boise National Forest

From 1964 to 1970, 12 fire weather stations were operated on the Boise National Forest in Idaho (fig. 1). A decision was made to terminate operations of 3 of the 12 stations after the 1970 fire season. Stations 2, 4, and 8 were closed on the basis of best judgment available. Subsequently, however, we used similarity analysis to determine which three stations could have been closed with least impact on fire climate evaluations throughout the Forest.

The season used in the analysis—the months of July and August—was divided into six, 10-day periods. All 36 variables were determined from the 7 years of record. The cluster pattern resulting from the analysis is shown in figure 2. This figure shows the groups of stations, or cluster memberships, for the specified number of clusters on the bottom. One cluster would obviously include all the stations. If we want to separate the 12 stations into 2 clusters, the stations (down the left) which fall above the vertical line dividing the "2" horizontal box would constitute a cluster, and those which fall below would constitute the second cluster. The same process applies for any number of clusters determined by the horizontal partitions of the vertical box corresponding to the number of clusters desired.

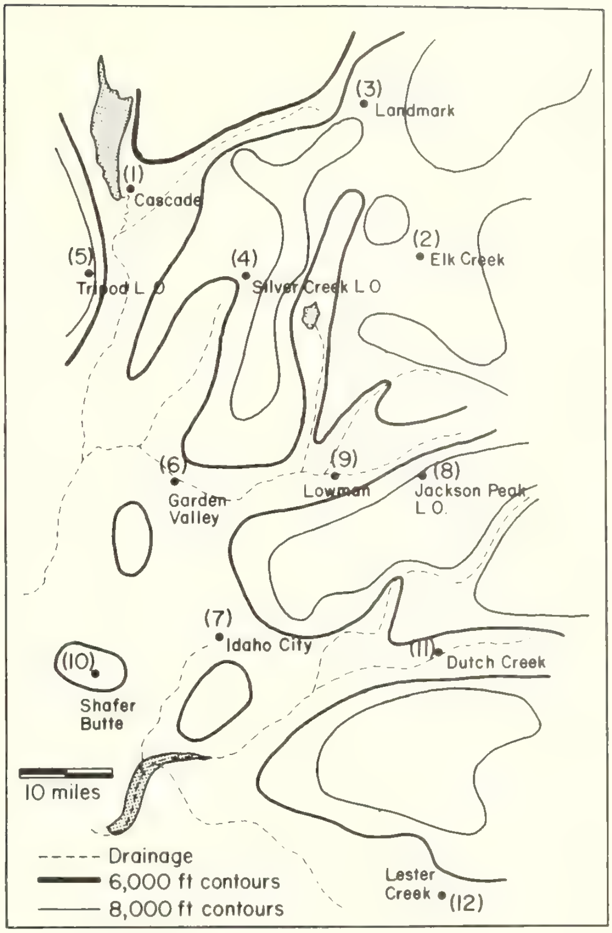
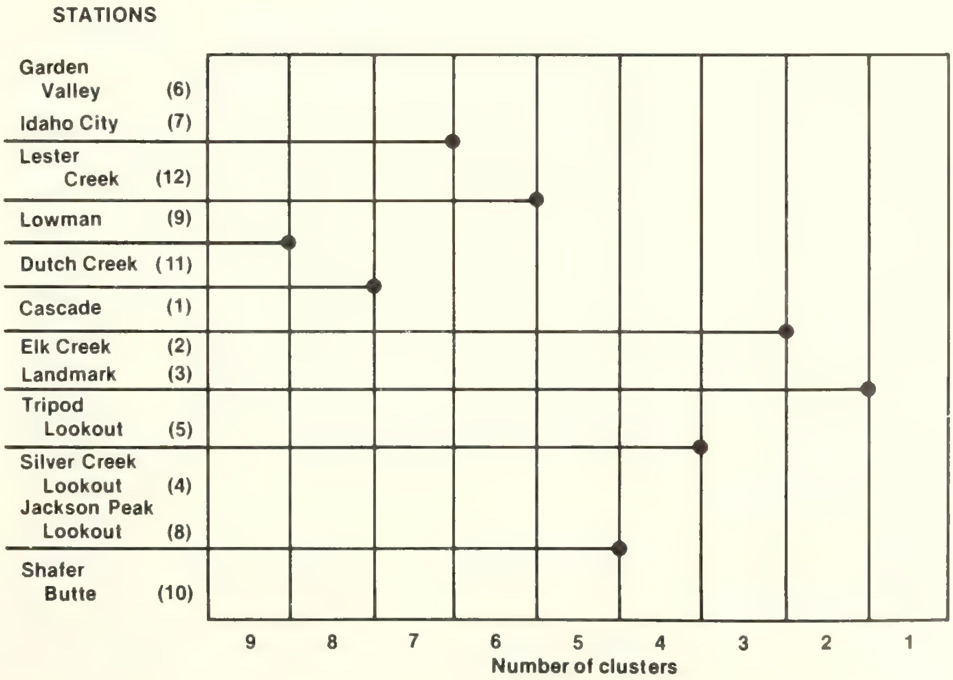


Figure 1.—Fire-danger stations with contours and drainages on the Boise National Forest, Idaho.

Figure 2.—Clusters of stations based on increasing levels of climate discrimination. Horizontal lines separate the stations (in the left margin) into the number of clusters indicated at the bottom of the figure. Cluster membership is determined by how the stations are grouped by the horizontal lines.



Since our problem was to reduce the network of 12 stations to 9, we were interested in how the stations could be arranged into 9 clusters. Looking at the divided box for nine clusters in figure 2, we see that three of the clusters are pairs of stations: (1) Garden Valley—Idaho City; (2) Elk Creek—Landmark; and (3) Silver Creek Lookout—Jackson Peak Lookout. This indicates that the two stations in each pair have fire climates that, according to our definition, are very similar. Therefore, one of each of these pairs should be considered for elimination. The remaining station of the pair would be a sufficient indicator of the climate at both locations. If three stations were to be eliminated, the loss of these three should minimize the loss of fuel-moisture information assessing fire danger on the Boise National Forest. One should keep in mind that wind must be considered separately, however.

The stations that have minimum impact on the sum-of-squares ratio (sum of squares final/sum of squares initial) are Landmark, Garden Valley, and Jackson Peak Lookout. They would be primary candidates for closure. Removing these stations from sampling network gives a sum-of-squares ratio of 0.83. This may be interpreted as meaning that the remaining 9 stations would monitor 83 percent of the variation that the original 12 stations monitored

Our technique suggests that all of the actually eliminated stations—2, 4, and 8—were among those to be considered for closure. However, stations 4 and 8 formed a pair that monitored a climate different from the rest down to the four-cluster level. Thus, current information about the areal distribution of fire danger is not as complete as if one of the pair 4,8 were still operational and one of the pair 6,7 had been removed.

Summary

The purpose of fire weather observation networks is to monitor the "average worst" fire danger conditions. In the mountainous West, this condition normally exists at midelevation on a south to west aspect. Thus the purpose specifies the location of fire weather stations. A second but no less important consideration for locating an observation station is that it monitor a climate representative of that which exists in the protection area. In other words, the weather measured at the local airport most likely does not monitor the "average worst" conditions on a nearby protection unit, and may not even be representative of the "average" weather conditions on that unit. These factors must be considered when evaluating the effectiveness of a fire weather station. Also, any reduction in the number of fire weather stations in an area reduces the information available to evaluate fire danger in that area.

The purpose of this paper is to present an analysis technique to aid fire managers if it becomes necessary for them to reduce the size of their fire weather observation networks. The variables used are related more to fire climate than to fire danger, and the variability of wind was not considered in the method.

The result of the data analysis technique proposed is information on the similarity structure of fire climates monitored in a protection area. Such information, in conjunction with other considerations, may be useful in streamlining fire weather monitoring networks.

Literature Cited

Ball, Geoffrey H., and David J. Hall.
1965. ISODATA, A novel method of data analysis and pattern classification. Tech. Rep. Stanford Res. Inst. Menlo Park, Calif.

Fosberg, Michael A., and R. William Furman.
1973. Fire climates in the Southwest. Agric. Meteor. 12:27-34.

Fosberg, Michael A., and John E. Deeming.
1971. Derivation of the 1- and 10-hour timelag fuel moisture calculations for fire danger rating. USDA For. Serv. Res. Note RM-207, 8 p., Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Fourt, D. F., and D. G. M. Donald, J. N. R. Jeffers, and W. O. Binns.
1971. Corsican pine (*Pinus nigra* var. *maritima* (Ait.) Melville) in Southern Britain. A study of growth and site factors. Forestry, XLIV, 189-207.

Furman, R. William.
1974. A study of the regionalization of wildfire climates. Ph.D. Diss. Colo. State Univ., Ft. Collins, Colo.

Jeffers, J. N. R.
1966. Principal component analysis in taxonomic research. Int. Adv. Group Forest Statist. IUFRO. Rapp. Uppsatser. Inst. Skoglig. Mat. Statist., Skogshogskolan, Stockholm, 9:138-159.

Morrison, Donald F.
1967. Multivariate Statistical Methods. McGraw Hill Book Co., New York, 338 p.

Newnham, R. M.
1968. A classification of climate by principal component analysis and its relationships to tree species distribution. For. Sci. 14:254-264.

Simard, A. J.
1968. The moisture content of forest fuels. I. A review of basic concept. Inf. Rep. FFX-14, 46 p. For. Fire Res. Inst., Ottawa, Ont.

Agriculture—CSU, Ft. Collins

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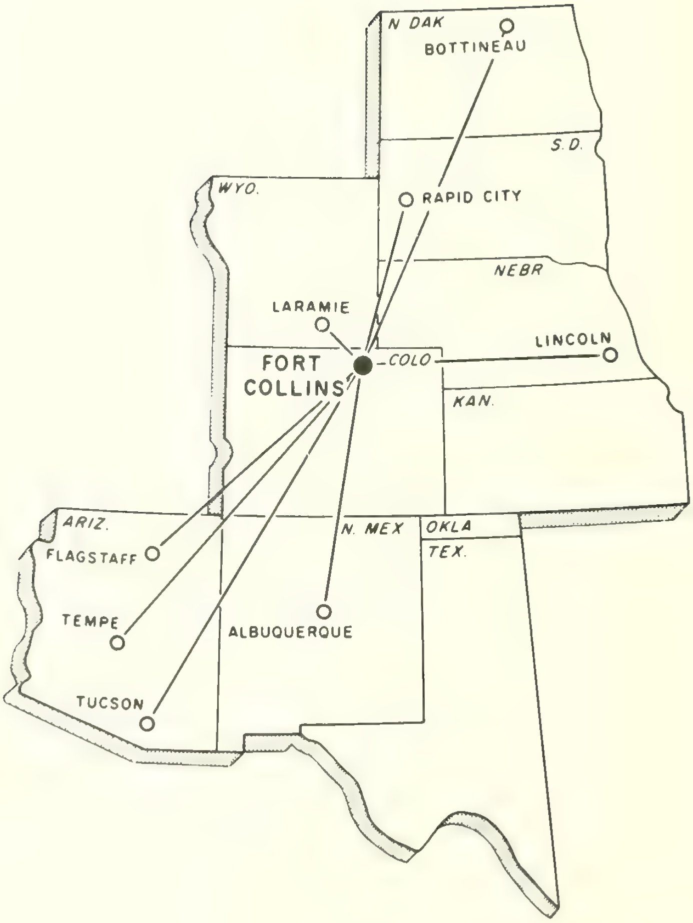
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USDA Forest Service
General Technical Report RM-18

October 1975

MANUAL OF THE RUSHES (*JUNCUS* SPP.) OF THE ROCKY MOUNTAINS AND COLORADO BASIN

Rocky Mountain Forest and
Range Experiment Station

Forest Service
U.S. Department of Agriculture
Fort Collins, Colorado 80521

Abstract

Hermann, Frederick J.
1975. Manual of the rushes (*Juncus* spp.) of the Rocky Mountains and Colorado Basin. USDA For. Serv. Gen. Tech. Rep. RM-18, 107 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521

A taxonomic treatment of the 51 taxa of the critical genus *Juncus* known from the Rocky Mountains and Colorado Basin. Detailed descriptions, synonymy, key for identification, illustrations, habitats, geographic distribution and data on forage value are included.

Keywords: Plant taxonomy, *Juncus*, Rocky Mountains, Colorado Basin, phytogeography, forage plants, Juncaceae.

USDA Forest Service
General Technical Report RM-18

October 1975

Manual of the Rushes (*Juncus* spp.) of the Rocky Mountains and Colorado Basin

Frederick J. Hermann
Curator Emeritus, Forest Service Herbarium
Rocky Mountain Forest and Range Experiment Station[1]

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[1] *Central headquarters and herbarium maintained at Fort Collins, in cooperation with Colorado State University.*

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SUMMARY

Juncus, of the family Juncaceae, is a genus of about 120 species and numerous geographical varieties in North America. It is best developed in temperate climates. Although morphologically a close relative of the Lily Family, the genus is characterized by small, greenish, scarious flowers. In appearance the plants are decidedly grasslike. Because distinguishing characteristics are in large part minute and because many of the species bear at least a superficial resemblance to others, identification is often difficult.

In this taxonomic treatment, the 51 recognized taxa include 38 species, 11 varieties, and 2 forms.

Keys for the identification of the species and subspecific taxa are provided, as well as detailed descriptions, synonymy, accounts of geographic distribution and habitats, and illustrations. Included are a systematic list of the taxa, a glossary and bibliography.

One new name is proposed, *Juncus bufonius* var. *occidentalis* F. J. Herm., for the American plant that has been erroneously passing as *J. sphaerocarpus* Nees.

INTRODUCTION

The Forest Service has frequently been asked to prepare a manual of the rushes of the Rocky Mountain area, similar to Agriculture Handbook No. 374 (1970), which deals with the sedges of the same region. As in *Carex*, many of the species of *Juncus* are of economic importance as forage and as a hay crop, and similar problems in their identification have been encountered by non-specialists due to the critical nature of the genus. No modern manual for the species of this area has heretofore been available. It is hoped that the present treatment will fulfill the expressed need.

The area covered by this manual is the same as that of Agriculture Handbook No. 374, *Manual of the Carices of the Rocky Mountains and Colorado Basin.* It includes the southern Rockies (in New Mexico, Colorado, and southern Wyoming); the middle Rockies (separated from the southern Rockies by the Wyoming Basin, and lying in northeastern Utah, northwestern Wyoming, and southern Idaho); and the ranges of the Colorado Basin in Arizona.

All pertinent taxonomic literature on the 38 species and 13 subspecific taxa here covered has been collated for distributional data and to bring the nomenclature up to date. Keys for identification and detailed descriptions are given. Notes on ecology and phytogeography are incorporated, and information on economic value is presented whenever available. A checklist of sections and species, a bibliography, and glossary are included. Illustrations are provided for all the taxa except the very few in which the difference from allied taxa is slight and better expressed verbally than pictorially. Grateful acknowledgment is made to the University of California Press for permission to reproduce illustrations from H. L. Mason's "Flora of the Marshes of California" (1957), to the University of Washington Press for illustrations from "Vascular Plants of the Pacific Northwest" by C. L. Hitchcock *et al.* (1969), and to Dr. Charles Feddema of the Forest Service Herbarium for drawings of species for which illustrations were not previously available.

The classification adopted is that of Buchenau (3) as modified by Vierhapper (21), except that the species having imperfectly septate leaves in Buchenau's Section *Septati* have been segregated as Section *Ensifolii*, as was done by Coville and by Rydberg in their several treatments.

ROCKY MOUNTAIN JUNCI

1. SECTION POIOPHYLLI

1. Juncus bufonius L.
1a. J. bufonius var. halophilus Buch. & Fern.
1b. J. bufonius var. occidentalis F. J. Herm.
2. J. compressus Jacq.
3. J. gerardii Loisel.
4. J. tenuis Willd.
4a. J. tenuis var. congestus Engelm.
4b. J. tenuis var. dudleyi (Wieg.) F. J. Herm.
5. J. interior Wieg.
6. J. confusus Coville
7. J. brachyphyllus Wieg.
8. J. vaseyi Engelm.

2. SECTION GENUINI

9. J. effusus L. var. compactus Hoppe in Lej. & Court.
9a. J. effusus var. exiguus Fern. & Wieg.
9b. J. effusus var. brunneus Engelm.
10. J. filiformis L.
11. J. drummondii E. Mey.
11a. J. drummondii var. subtriflorus (E. Mey.) C. L. Hitchc.
12. J. parryi Engelm.
13. J. hallii Engelm.
14. J. balticus Willd. var. montanus Engelm.
14a. J. balticus var. vallicola Rydb.
15. J. mexicanus Willd.

3. SECTION THALASSII

16. J. acutus L. var. sphaerocarpus Engelm.

4. SECTION GRAMINIFOLII

17. J. marginatus Rostk.
17a. J. marginatus var. setosus Coville
18. J. regelii Buch.
19. J. longistylis Torr.
19a. J. longistylis var. scabratus F. J. Herm.
20. J. macrophyllus Coville
21. J. covillei Piper var. obtusatus (Engelm.) C. L. Hitchc.
22. J. bryoides F. J. Herm.

5. SECTION ALPINI

23. J. biglumis L.
24. J. albescens (Lange) Fern.
25. J. castaneus J. E. Smith.

6. SECTION SEPTATI

26. J. brachycephalus Engelm.
27. J. tweedyi Rydb.
28. J. acuminatus Michx.
29. J. nodosus L.
30. J. torreyi Coville
31. J. articulatus L.
32. J. alpinus Vill.
33. J. mertensianus Bong.
34. J. nevadensis Wats.
34a. J. nevadensis var. badius (Suksd.) C. L. Hitchc.

7. SECTION ENSIFOLII

35. J. ensifolius Wikst.
36. J. xiphioides E. Mey.
37. J. tracyi Rydb.
38. J. saximontanus A. Nels.
38a. J. saximontanus f. brunnescens (Rydb.) F. J. Herm.

JUNCUS L. RUSH

Perennial or, infrequently, annual, cespitose to strongly rhizomatous, grasslike herbs with terete to flattened, leafless to leafy stems; leaves glabrous, with a sheathing base, the sheath often prolonged upward on the sides at the juncture with the blade to form rounded to acuminate auricles, the blade from terete to laterally or dorsiventrally flattened, often with conspicuous partitions (septa) within; inflorescence terminal (sometimes appearing lateral when the involucral bract is terete and prolonged), cymose, diffuse and panicle-like to greatly congested, sometimes of one to many capitate clusters, the flowers small, greenish to purplish-brown, few (rarely only one) to many, the lowest (involucral) bract sometimes reduced but often greatly elongate, flat to terete; perianth regular, more or less chaff-like or scale-like in texture, persistent during fruiting, undifferentiated, the segments subequal or the inner series often the shorter; stamens 6 or 3 (when the latter, opposite the outer perianth segments), the filaments from shorter to much longer than the anthers; ovary superior; capsule loculicidal, three-valved, one-celled with three parietal placentae or three-celled from the intrusion of the placentae; seeds numerous, minute, usually more or less fusiform, often apiculate to caudate at one or both ends, faintly reticulate or areolate.

Distinguished from our other Juncaceous genus, *Luzula*, by its glabrous leaves and numerous (instead of three) seeds, and from other genera of the Liliales by its sedge-like aspect and from the grasses and sedges by its perianth of 6 segments and its capsular fruit.

KEY TO THE SPECIES

1. Low annuals; leaves narrow, rarely over 1 mm wide, often involute.
    2. Plants at least 3 cm tall, the flowers usually lateral as well as terminal on the stems; perianth segments 2-7 mm long; stamens 6.
        3. Capsule oblong to oblong-ovoid, 3-4.5 mm long; perianth segments 4-7 mm long; plants often over 15 cm tall.
            4. Flowers inserted singly at the nodes, remote; perianth segments plainly exceeding the capsule, the inner acuminate; seeds apiculate .... 1. *J. bufonius*
            4. Flowers often in twos or threes and more or less congested; inner perianth segments obtuse, barely exeeding the capsule; seeds abruptly truncate at the ends .... 1a. *J. bufonius* var. *halophilus*
        3. Capsule subglobose to broadly ovoid, 2-3 mm long; perianth segments 2-4 mm long; plants usually less than 15 cm tall. .... 1b. *J. bufonius* var. *occidentalis*
    2. Plants not over 1.5 cm tall, scapose, the flowers in a terminal, one-flowered head on a naked flowering stem; perianth segments 1.5-2 mm long; stamens 3 .... 22. *J. bryoides*
1. Plants perennial, usually at least 1 dm tall; leaves often much more than 1 mm wide.
    5. Inflorescence apparently lateral, the involucral bract terete, stiffly erect, appearing like a continuation of the stem; leaves all basal or nearly so, never septate.
        6. Seeds tailed; flowers few (1-5); densely cespitose alpine plants without prolonged rootstocks; involucral bract rarely as much as 5 cm long.
            7. Uppermost leaf-sheath bristle-tipped, the blades reduced to a mere rudiment; capsule oblong, retuse.
                8. Mature capsule about equally or only slightly exceeding the perianth, the perianth mostly 6-7 mm long .... 11. *J. drummondii*
                8. Mature capsule usually at least 1 mm longer than the perianth, the perianth (4)5-6(8) mm long .... 11a. *J. drummondii* var. *subtriflorus*
            7. Uppermost leaf-sheath bearing a well developed blade, mostly 2-7 cm long.
                9. Capsule oblong, acute; perianth 6-9 mm long .... 12. *J. parryi*
                9. Capsule ovoid, retuse; perianth 4-5 mm long .... 13. *J. hallii*
        6. Seeds not tailed; flowers several to many (6-20); plants with prolonged rootstocks, not often alpine; involucral bract usually more than 5 cm long.

10. Anthers mostly less than 1 mm long, from shorter to only slightly longer than the filaments.
    11. Stamens 3 (occasionally 6); perianth 1.8-2.9 mm long; capsule slightly obovoid, distinctly triquetrous above; involucral bract rarely half as long as the stem.
        12. Flowers small, the perianth segments 1.8-2.5 mm long, mostly somewhat spreading from the base, greenish to pale brown.
            13. Inflorescence small, compact; culms rather stout, 1.5-4 mm in diameter at the top of the sheaths .... 9. *J. effusus* var. *compactus*
            13. Inflorescence much more open, loosely fastigiate; culms very slender, 1-1.5 mm in diameter at the top of the sheaths .... 9a. *J. effusus* var. *exiguus*
        12. Flowers larger, 2.5-2.9 mm long, rarely spreading, very dark brown, the perianth segments bordered by two dark brown lateral bands .... 9b. *J. effusus* var. *brunneus*
    11. Stamens 6; perianth often more than 3.5 mm long; capsule broadly ovoid to obovoid, not triquetrous; involucral bract from half as long as the stem to exceeding .... 10. *J. filiformis*
10. Anthers 1.2-2.2 mm long, as least twice as long as the filaments.
    14. Flowers inserted singly on the branches, each subtended by a pair of bractlets; capsule not heavily indurated, little if at all exceeding the perianth.
        15. Upper leaf sheaths without blades; stems usually terete.
            16. Stems up to 3 dm high, slender, about 1.5 mm in diameter at the base; inflorescence congested and usually subcapitate, generally about 1 cm long; perianth segments 4-5.5 mm long, scarious margined, subequal .... 14. *J. balticus* var. *montanus*
            16. Stems taller, often 6 dm high, stouter, 2-4 mm in diameter at the base; inflorescence diffuse, mostly 5-15 cm long; perianth segments 5-6 mm long, dark brown margined, the outer longer than the inner .... 14a. *J. balticus* var. *vallicola*
        15. Upper leaf sheaths usually bearing a well-developed blade; stems compressed, often twisted .... 15. *J. mexicanus*
    14. Flowers inserted in small headlike clusters, without bractlets but the clusters bracteate; capsule heavily indurated, much exceeding the perianth. (Arizona only.) .... 16. *J. acutus* var. *sphaerocarpus*

5. Inflorescence obviously terminal, or if not the leaves septate and the involucral bract flat or channeled along the upper side, not strictly erect nor resembling a continuation of the stem.
    17. Leaf blades not septate, transversely flattened (inserted with the flat surface facing the stem), involute or hollow.
        18. Flowers borne singly on the branches of the inflorescence (not in heads), each with a pair of bracteoles at the base in addition to the bractlet at the base of the pedicel.
            19. Outer perianth segments obtuse, with incurved or hooded tips, often of two colors; leaf sheaths extending halfway up the culm; rhizome horizontal, becoming slender and elongate.
                20. Anthers scarcely longer than the filaments; capsule globose-obovoid, distinctly exserted .... 2. *J. compressus*
                20. Anthers about three times the length of the filaments; capsule ellipsoid-ovoid, equally or but slightly exceeding the perianth .... 3. *J. gerardii*
            19. Outer perianth segments acute, uniformly colored (except for scarious margins), their tips ascending or spreading-ascending; leaf sheaths confined to the base or lower third of the plant; rhizomes short and erect, mostly hidden in the tussock of crowded crowns.
                21. Capsule one-celled, with septa extending halfway to the center, acutish to obtuse, not retuse.
                    22. Auricles at the summit of the sheaths membranaceous, white and scarious, conspicuously produced beyond the point of insertion, 0.5-6 mm long; bracteoles blunt.
                        23. Leaves usually from half the length of the stems to much longer; auricles very thin, much longer (up to 6 mm) than broad; inflorescence open, generally more than 3 cm long; perianth often less than 4 mm long, the segments greenish .... 4. *J. tenuis*
                        23. Leaves mostly less than half as long as the stems, stiffer; auricles membranaceous, generally less than 1 mm long; inflorescence usually congested, mostly less than 3 cm long; perianth usually no less than 4 mm long; the segments brownish with a broad, green midstripe .... 4a. *J. tenuis* var. *congestus*
                    22. Auricles firm, not conspicuously produced beyond the point of insertion.
                        24. Auricles cartilaginous, yellow, very rigid and glossy, especially the short, produced portion; bracteoles blunt; sheaths of basal

leaves stramineous or brown .... 4b. *J. tenuis* var. *dudleyi*

24. Auricles with the very slightly produced portion submembranaceous, not rigid, easily broken; bracteoles acuminate or aristate; sheaths of the basal leaves commonly purplish .... 5. *J. interior*

21. Capsule completely three-celled.
    25. Seeds apiculate, not caudate; leaves flat, but often involute or channeled.
        26. Perianth segments 3.5-4 mm long, broadly scarious-margined to the blunt or short-pungent apex, fuscous with a broad greenish midstripe, subequal, little if at all exceeding the retuse capsule; flowers few, usually congested; leaves long and very narrow; stem slender .... 6. *J. confusus*
        26. Perianth segments 4-5.5 mm long, the outer series not scarious-margined at the acuminate, long-pungent apex, greenish to stramineous, conspicuously exceeding the inner series and the obtuse to retuse capsule; flowers numerous in an open cyme; leaves shorter and broader (1-2 mm wide); stem stout ... 7. *J. brachyphyllus*
    25. Seeds long-caudate; leaves terete, with a shallow groove above .... 8. *J. vaseyi*

18. Flowers in heads, not bracteolate, having only the bractlet at the base of the pedicel.
    27. Leaves flat.
        28. Seeds tailed; ligule absent; auricles lacking or, when present, narrowly linear and less than 1 mm long .... 18. *J. regelii*
        28. Seeds not tailed; sheath margins generally united above to form a short, broad ligule; auricles when present broadly ovate.
            29. Stamens 3; perianth 2-3.5 mm long.
                30. Inner perianth segments ovate to oblong, blunt to mucronate; capsule dull, lusterless .... 17. *J. marginatus*
                30. Inner perianth segments lance-attenuate, subulate-tipped; capsule glossy .... 17a. *J. marginatus* var. *setosus*
            29. Stamens 6; perianth 5-6 mm long (except in *J. covillei* var. *obtusatus,* where the length is 3-4 mm.)
                31. Leaf sheath and blade rather sharply differentiated, the auricles evident.

32. Outer perianth segments exceeding or equaling the inner; leaf blades flat.

33. Vegetative parts smooth; auricles obtuse to truncate .... 19. *J. longistylis*

33. Vegetative parts (especially leaf apices and pedicels) strongly scabrous .... 19a. *J. longistylis* var. *scabratus*

32. Outer perianth segments distinctly shorter than the inner; leaf blades channeled ..... 20. *J. macrophyllus*

31. Leaf sheath passing gradually into the blade, the auricles lacking or poorly developed, especially in the basal leaves .... 21. *J. covillei* var. *obtusatus*

27. Leaves terete and hollow or deeply channeled or involute; seeds tailed.

34. Flowers 3-5 mm long; leaves about 1 mm in diameter; stems leafy only at the base; plants cespitose.

35. Capsule retuse; heads 1- 2-flowered; perianth dark brown to blackish; involucral bract foliaceous, erect .... 23. *J. biglumis*

35. Capsule obtuse and mucronate; heads 2- 5-flowered; perianth pinkish-white to light chestnut-colored; involucral bract more or less membranaceous, divergent .... 24. *J. albescens*

34. Flowers 5-10 mm long; leaves about 2 mm in diameter; stems more or less leafy; plants stoloniferous .... 25. *J. castaneus*

17. Leaf blades septate.

36. Leaf blades terete, the septa complete, mostly less than 3 mm wide.

37. Seeds tailed; stamens usually 3.

38. Heads numerous, small, 2- 5- flowered; perianth segments 1.75-2.5 mm long .... *26. *J. brachycephalus*

38. Heads 4-10, larger, 4- 8-flowered; perianth segments 3.5-4 mm long; often associated with hot springs .... 27. *J. tweedyi*

37. Seeds usually apiculate but not tailed.

39. Stamens 3; plant cespitose .... 28. *J. acuminatus*

39. Stamens 6; plants often stoloniferous

40. Capsule subulate; flowers echinate-spreading.

41. Plant low, 1-4 dm high; perianth 3-4 mm long, the inner segments equaling or exceeding the outer; heads scarcely 10 mm

broad; leaf blades erect or ascending .... 29. *J. nodosus*

41. Plant taller, 4-10 dm high; perianth (4)4.5-5 mm long, the inner segments shorter than the outer; heads 10-15 mm broad; leaf blades abruptly divergent .... 30. *J. torreyi*

40. Capsule oblong to ovoid or obovoid; flowers erect-ascending.

42. Perianth 2-3 mm long; capsule usually exceeding the perianth.

43. Outer perianth segments acuminate, equaling or shorter than the inner; branches of the inflorescence mostly spreading; capsule acute .... 31. *J. articulatus*

43. Outer perianth segments blunt, longer than the inner; branches of the inflorescence stiffly erect; capsule distinctly rounded at the apex .... 32. *J. alpinus*

42. Perianth 3-5.5 mm long; capsule shorter than or equaling the perianth.

44. Head solitary, or rarely two, more than 12-flowered; perianth deep brown; anthers rarely more than two-thirds as long as the filaments; capsule slightly obovoid, the valves broadened above the middle and then abruptly rounded to almost truncate, the tip often slightly retuse; plants mainly montane to alpine .... 33. *J. mertensianus*

44. Heads (2)5-many, mostly with less than 12 flowers; perianth from light brown to dark purplish-brown; anthers more than two-thirds as long as the filaments (usually exceeding them); capsule and valves oblong or nearly so, the valves gradually rounded to acute at the tip; plants often of the lowlands.

45. Perianth segments 3-5.5 mm long; heads usually 5-30; anthers usually much longer than the filaments .... 34. *J. nevadensis*

45. Perianth segments about 3 mm long; heads 2-5; anthers only slightly longer than the filaments . . 34a. *J. nevadensis* var. *badius*

36. Leaf blades laterally flattened, equitant (one edge toward the stem), the septa incomplete (not extending all the way across the blade), mostly 3-6 mm wide.
  46. Stamens 3; involucral bract ensiform, usually half the length of the inflorescence or more .... 35. *J. ensifolius*
  46. Stamens 6; involucral bract narrower, usually less than half the length of the inflorescence.
    47. Perianth segments equal in length, very narrow and thin, usually slightly shorter than the oblong, acute capsule, spreading, overlapping only near the base, thus exposing about three-fourths of the capsule; blades of the larger leaves 7-12 mm wide; stems stout .... 36. *J. xiphioides*
    47. Perianth segments unequal, the inner ones shorter, segments broader and firmer in texture, usually exceeding the oblong-obovoid capsule, appressed, overlapping most of their length, thus exposing little of the capsule; blades of the larger leaves seldom more than 4 mm wide; stems relatively slender; valves of the capsule more rigid than in *J. xiphioides.*
      48. Seeds tailed; style long-exserted .... 37. *J. tracyi*
      48. Seeds not tailed; styles usually little if at all exserted.
        49. Heads few (seldom more than 10), many (15-25)-flowered, averaging 7-10 mm in diameter .... 38. *J. saximontanus*
        49. Heads numerous (usually more than 10), few (5-12)-flowered, averaging 5-6 mm in diameter .... 38a. *J. saximontanus* f. *brunnescens*

SPECIES DESCRIPTIONS

1. § POIOPHYLLI

1. Juncus bufonius L. Toad Rush

Juncus bufonius L., Sp. Pl. 328. 1753.

Polymorphic, tufted annual, branching from the base; *stems* low and slender, 3-30 cm high, often floriferous nearly to the base; *leaves* few, flat to involute, up to 1.5 mm wide, the sheaths from tapering into the blade, to truncate or rounded at the apex, their margins membranaceous; *cyme* open, often one-third to three-fourths of the entire plant; *flowers* remote, either single at the nodes or in twos or threes and more or less congested, 2-7 mm long, whitish, greenish or pale brown, subtended by two hyaline bracts 1-2 mm long; *perianth segments* lanceolate-acuminate or the inner obtuse, 2-7 mm long, broadly scarious-margined, the outer three longer than the inner; *stamens* usually 6, sometimes 3; *anthers* from very much shorter than to subequal to the filaments; *capsule* oblong to subglobose or broadly ovoid, 2-4.5 mm long, shorter than the perianth, obtuse, mucronate; *seeds* slenderly ovoid to ellipsoid, apiculate to abruptly truncate at each end, minutely reticulate, 0.3-0.5 mm long.

Juncus bufonius L., var. **bufonius**

Plants often over 15 cm high; *flowers* usually single at the nodes; *perianth segments* 4-7 mm long, plainly exceeding the capsule, the inner acuminate; *capsule* oblong to oblong-ovoid, 3-4.5 mm long; *seeds* apiculate.

Frequent to common in moist, open areas, especially around dried pools, river banks, etc., from low to mid-altitudes or occasionally subalpine. Cosmopolitan except in the tropics and extreme arctic.

Forage Value

Although a few collectors have reported the species as being of little value (in Sequoia National Forest, California, for example), it is generally claimed to be from good to excellent (Kootenai National Forest, Montana and Stanislaus National Forest, California) for all classes of stock.

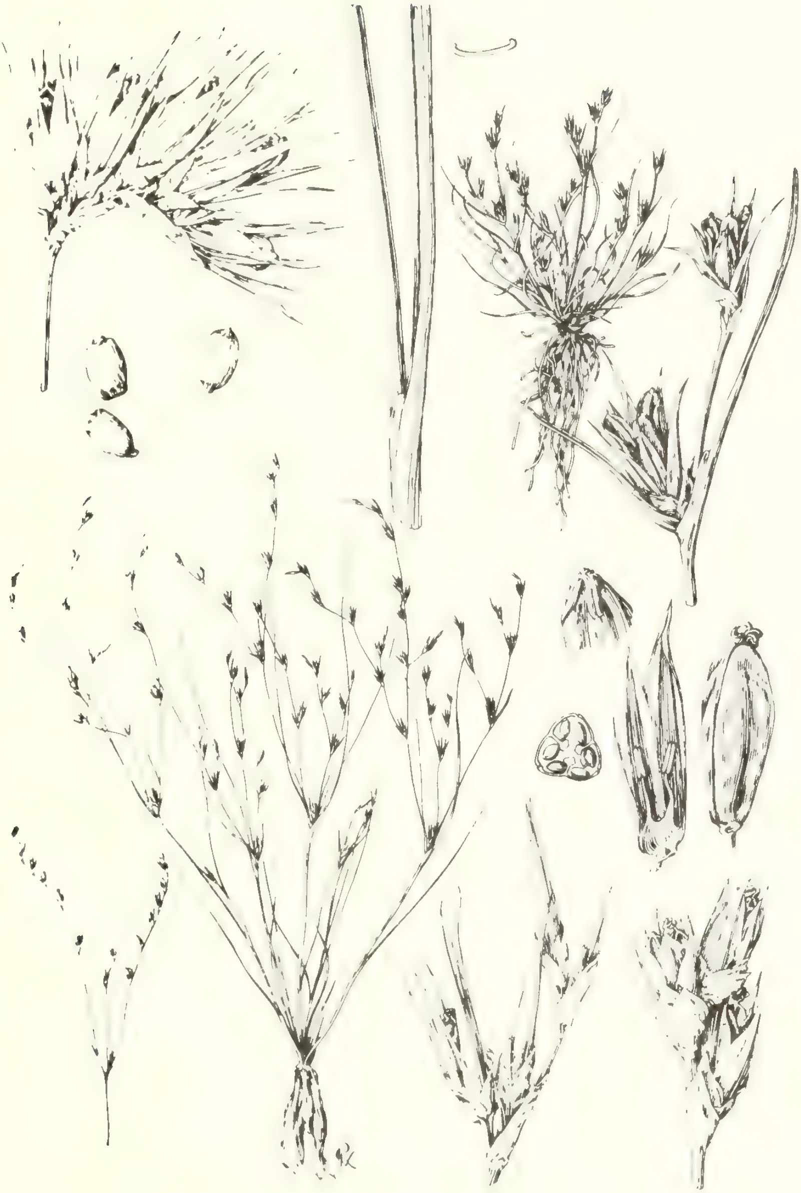


Plate 1. JUNCUS BUFONIUS

(From Mason: Flora of the California Marshes)

1a. **Juncus bufonius** var. **halophilus** Buch. & Fern.

Juncus bufonius var. *halophilus* Buch. & Fern., Rhodora 6: 39. 1904.

Flowers often in twos and threes and more or less congested; inner perianth segments obtuse, barely exceeding the capsule; *seeds* abruptly truncate at the ends.

Rare to infrequent in our area, usually in brackish or saline habitats at low to mid-altitudes; common on the Atlantic Coast. Labrador and Quebec, southward to Massachusetts and New York; Saskatchewan to Nebraska and Colorado; Europe.

1b. **Juncus bufonius** var. **occidentalis** F. J. Herm.

Juncus bufonius var. *occidentalis* F. J. Herm., nom. et stat. nov.
J. sphaerocarpus auct. Am., non Nees.

Plants usually less than 15 cm high; *perianth segments* 2-4 mm long; *capsule* subglobose to broadly ovoid, 2-3 mm long.

Occasional on mud flats, lake borders and other moist habitats; frequent in Arizona. Oregon and Idaho, southward to California, Colorado, and Arizona.

As pointed out by Hitchcock (in Hitchcock, Cronquist, Ownbey and Thompson, *Vascular Plants of the Pacific Northwest* 1: 191. 1969), this American plant that has been passing as *J. sphaerocarpus* Nees, of Europe, differs from it in its much narrower, unequal perianth segments that conspicuously exceed the capsule and in its lack of auriculate sheaths. Although transitional forms occur between var. *occidentalis* and var. *bufonius*, it does show a marked geographic segregation from typical *J. bufonius*, not occurring at all in eastern North America, and therefore merits varietal recognition.

Forage Value

Reports on this variety indicate that in nearly all areas of its occurrence it is highly palatable. In the Apache National Forest, Arizona, where it often forms a moss-like carpet below larger sedges, bluestem, clover and iris, it is annually almost exterminated by sheep.

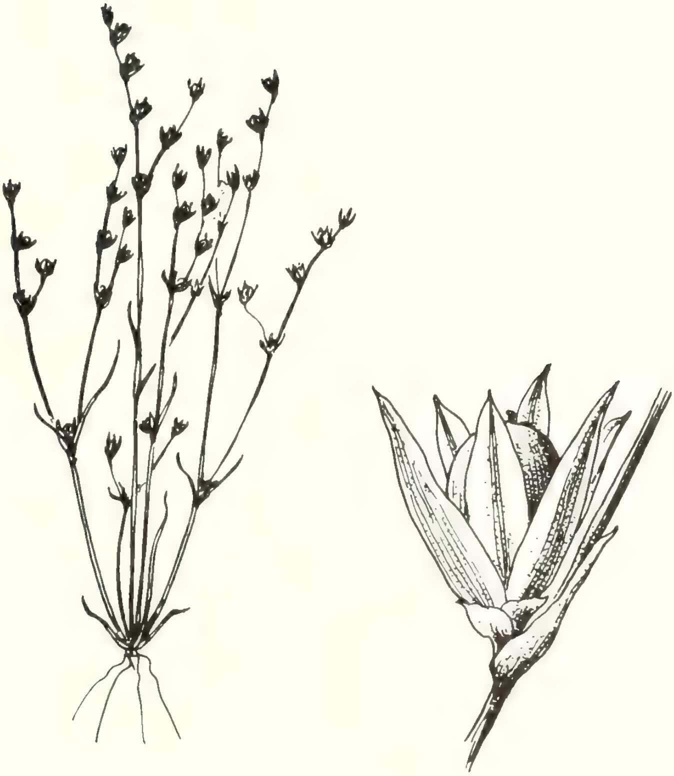


Plate 1b. JUNCUS BUFONIUS VAR. OCCIDENTALIS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

2. **Juncus compressus** Jacq.

Juncus compressus Jacq., Enum. Stirp...Vindobon. 60 and 235. 1762.
J. bulbosus L., Sp. Pl., ed. 2, 466. 1762, non ed. 1. 1753.

Tufted glaucous perennial; *rhizome* horizontal, seldom more than 5 cm long; *stems* curved, not stiffly erect, smooth, usually compressed throughout their length, 10-40 cm high, bearing 1-2 leaves; *leaves* narrowly linear, 0.75-1 mm wide, usually shorter than the stems, long-sheathed with obtuse auricles; *inflorescence* compound or decompound, lax to compact, usually shorter than the lowest bract; *perianth segments* equal, 1.5-2 mm long, lanceolate-ovate, very obtuse, light brown with greenish center and membranaceous margins, the sepals with incurved tips; *stamens* 6, their anthers linear, slightly longer than the filaments; *style* shorter than the ovary; *capsule* subglobose, obtuse, about one and one-half times as long as the perianth, castaneous, very glossy; *seeds* 0.35-0.4 mm long, obliquely obovoid, apiculate.

Wet meadows and brackish marshes. Three collections are so far known from our area: marshy roadside ditch, 9 mi S. of Wisdom, Beaverhead County, Mont., Sept. 8, 1955, *F. J. Hermann 12484* (CA; MONT; US); open wet soil adjoining bait minnow ponds, C.S.U. Foothills Campus, Fort Collins, Larimer County, Colo., Oct. 10, 1967, *S. A. Flickinger 1* (CS), and, sedge meadow south of Spring Canyon, 5 mi SW. of Fort Collins, Larimer County, Colo., June 27, 1971, *F. J. Hermann 23841* (COLO; NY; USFS). Newfoundland, Nova Scotia, Prince Edward Island to eastern Ontario; almost certainly introduced in western United States and possibly also in the East. Widely distributed in Eurasia.

3. Juncus gerardii Loisel. Black Grass

Juncus gerardii Loisel. in Desv., J. de Bot. 2: 284. 1809.
J. fucensis St. John, Rep. Prov. Mus. Nat. Hist. B.C. 1927: E14. 1928.

Closely resembling *J. compressus.* Tufted green perennial; *rhizomes* and slender stolons dark, elongate and horizontally spreading; *stems* stiffly ascending, scarcely flattened except below, 15-80 cm high, with 1-2 cauline leaves, 1-3 mm wide; *inflorescence* usually more lax with straighter less spreading branches than in *J. compressus,* usually exceeding the lowest bract; *perianth segments* equal, 2-3.5 mm long, dark brown to blackish with green central stripe, the sepals with incurved tips; *stamens* 6, their anthers about three times as long as the filaments; *style* equaling or exceeding the ovary; *capsule* ellipsoid-ovoid, mucronate, shorter than to barely exceeding the perianth; *seeds* obovoid, 0.4-0.6 mm long.

Salt marshes and alkaline flats. Known from three collections in our area: dominant on alkali flats, Beasley Reservoir, 6 mi NE. of Boulder, Boulder County, Colo., July 16, 1952, *W. A. Weber 7787* (COLO); marshy roadside on US 56 about 2 mi S. of Barr Lake, Adams County, Colo., July 26, 1954, *D. A. Spencer, s.n.* (COLO); and, in Carex slough along Boulder Creek just W. of brick works, Valmont, Boulder County, Colo., July 12, 1970, *W. A. Weber, s.n.* (COLO). Newfoundland and Quebec southward along the coast to Florida, and locally inland to Indiana, Minnesota, Missouri, Colorado, and British Columbia; Eurasia and north Africa.

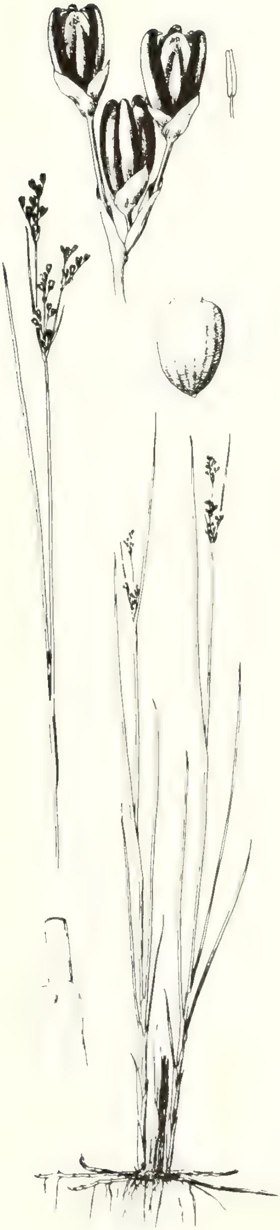


Plate 3. JUNCUS GERARDII

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

4. Juncus tenuis Willd. Path Rush

Juncus tenuis Willd., Sp. Pl. 2: 214. 1799.
J. macer S. F. Gray, Natl. Arn. Brit. Pl. 2: 164. 1821.

Cespitose perennial; *stems* slender, 0.5-7 dm high, from bright green to pale green or drab; *leaves* chiefly basal, from less than one-half the length of to exceeding the culms, the blades flat, not septate, 0.5-1.5 mm wide, in drying often involute, the sheaths prolonged above into elongate-membranaceous to short-cartilaginous auricles; *lower bract* or bracts prolonged above the cyme; *cyme* 1-15 cm long, either compact or with unequal, ascending branches with 2-6 approximate flowers; bracteoles obtuse; *perianth segments* green or stramineous or tawny with green midrib, 3-5 mm long, acute to subulate, spreading-ascending, from equaling to much longer than the capsule; *stamens* 6, the anthers 0.6-0.8 mm long, shorter than the filaments; *style* very short; *capsule* oblong-ovoid, usually retuse, one-celled, the placentae extending only half way to the axis; *seeds* 0.3-0.4 mm long, obliquely ovoid-ellipsoid, minutely apiculate, obscurely reticulate.

An extremely variable taxon.

The seeds in *J. tenuis* and its near allies (Nos. 4 through 8) are covered with a mucilaginous coat which, after exposure to rain or dew, becomes very sticky. This no doubt contributes to dispersal of the seeds. When, however, they become wet before falling from the capsule, they will later be found glued together into a single hardened mass, firmly attached to the septa and inner walls of the capsule.

Juncus tenuis Willd., var. **tenuis**
Juncus tenuis var. *multicornis* E. Mey., Linnaea 3: 371. 1828.

Leaves usually half as long as the stems to much longer; *auricles* very thin, membranaceous, lanceolate-triangular to oblong, much longer (often over 5 mm) than broad, usually greenish to whitish; *inflorescence* open, generally more than 3 cm long; *perianth* often less than 4 mm long, the segments greenish.

Open, usually damp grassy places and bordering paths and trails. Occasional in the southern part of our range, more plentiful in Montana and Idaho; very common in eastern and central North America. Almost cosmopolitan.

Forage Value

Occasionally palatable and of fair value, but generally poor.

4a. Juncus tenuis var. **congestus** Engelm.

Juncus tenuis var. *congestus* Engelm., Trans. Acad. Sci. St. Louis 2: 450. 1866.
J. tenuis var. *occidentalis* Coville, Proc. Biol. Soc. Wash. 10: 129. 1896.
J. occidentalis (Coville) Wieg., Bull. Torrey Club 27: 521. 1900.

Leaves mostly less than half as long as the stems, stiffer; *auricles* membranaceous, mostly less than 1 mm long; *inflorescence* generally congested, mostly less than 3 cm long; *perianth* usually no less than 4 mm long, the segments brownish with a broad green central stripe.

More common in the Pacific States but extending eastward to Montana, Wyoming, and Utah.

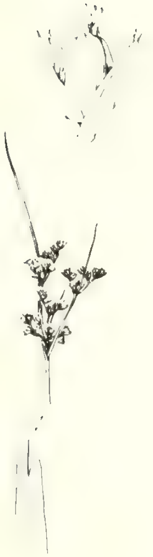


Plate 4. JUNCUS TENUIS

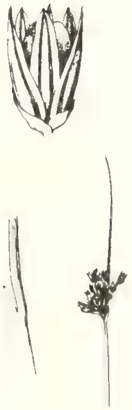


Plate 4a. JUNCUS TENUIS VAR. CONGESTUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

4b. **Juncus tenuis** var. **dudleyi** (Wieg.) F. J. Herm.

Juncus tenuis var. *dudleyi* (Wieg.) F. J. Herm., J. Arn. Arbor. 25: 56. 1944.

J. dudleyi Wieg., Bull. Torrey Club 27: 524. 1900.

Auricles short (mostly 0.5 mm long), indurated and cartilaginous, yellow to brown, glossy; *bracteoles* blunt to acute; *flowers* few, mostly congested into an inflorescence 1-5 cm long; *perianth* 4-6 mm long, widely spreading.

Although in its extreme form var. *dudleyi* is conspicuously distinct from var. *tenuis*, and most of the plants in eastern and central United States are of this extreme type, transitional forms become increasingly plentiful southwestward until they outnumber the extremes. Because of this it is highly impracticable to attempt to maintain var. *dudleyi* at specific level. In the Mississippi Valley, in particular, it also intergrades with *J. dichotomus.*

The name *J. tenuis* var. *uniflorus* (Farw.) Farw. has been proposed for this variety (Mich. Bot. 11: 34. 1972). Farwell, however, never made the transfer of his *J. interior* var. *uniflorus* (the type of which is an extremely depauperate, atypical specimen of var. *dudleyi*) to *J. tenuis.* The thesis that he intended to do so being based upon surmise only, under the International Rules of Botanical Nomenclature this name can have no standing. As pointed out by McVaugh, Cain and Hagenah (Cranbrook Inst. Sci. Bull. 34: 44. 1953), Farwell's "published papers do not indicate in any way that the names as published under *J. tenuis* are actually new combinations, and accordingly they must be treated as wholly new names, based on new types." The type collection designated by McVaugh *et al.* for Farwell's *J. tenuis* var. *uniflorus* is a mixture of var. *tenuis* and var. *dudleyi.*

Frequent to fairly common in moist places, mostly on plains and mesas. Newfoundland to British Columbia, southward to Tennessee, New Mexico, California, and northern Mexico.

Forage Value

As a rule somewhat more palatable than the typical variety, especially to cattle and horses, and occasionally up to 80 percent grazed.

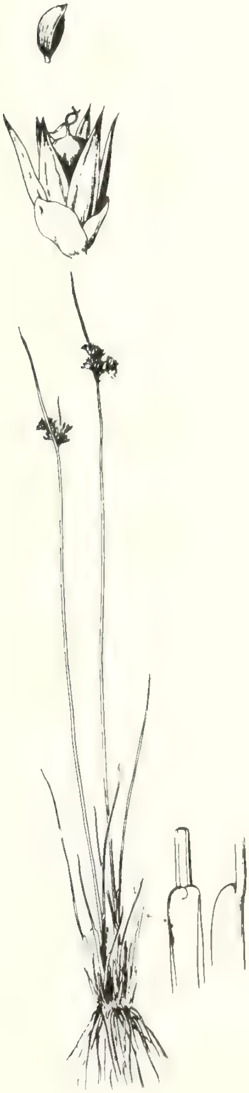


Plate 4b. JUNCUS TENUIS VAR. DUDLEYI

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

5. Juncus interior Wieg.

Juncus interior Wieg., Bull. Torrey Club 27: 516. 1900.
J. arizonicus Wieg., Bull. Torrey Club 27: 517. 1900.
J. neomexicanus Wieg., Bull. Torrey Club 30: 447. 1903.
J. interior var. *arizonicus* (Wieg.) F. J. Herm., J. Wash. Acad. Sci. 30: 217. 1940.
J. interior var. *neomexicanus* (Wieg.) F. J. Herm, J. Wash. Acad. Sci. 30: 217. 1940.

Cespitose perennial, very similar in habit to *J. tenuis; leaves* flat to involute, the pale brown to drab or purplish sheaths membranaceous-margined, occasionally somewhat cartilaginous below the summit, the submembranaceous to firm pale brown or drab auricles short, gradually rounded; *inflorescence* generally loose; *bracteoles* from lanceolate and acuminate to broadly ovate and acute or abruptly aristate; *perianth* mostly stramineous, from erect to spreading, 3-4 (3-5 in vars.) mm long, equaling or exceeding the capsule.

There is some question whether *J. interior* is actually specifically distinct because of strongly transitional forms between it and *J. dichotomus* in the Mississippi Valley and between it and *J. tenuis* var. *dudleyi* in other parts of its range.

Fairly common on moist open soil, especially on lake and pond margins, on plains and in the foothills; var. *arizonicus* (bracteoles lanceolate, acuminate; *perianth segments* erect, rigid, lanceolate-acuminate, with narrow, relatively opaque, hyaline margins) occurs in Arizona, and var. *neomexicanus* (bracteoles broadly ovate, acute to abruptly aristate; *perianth segments* spreading, not rigid, broadly ovate, acuminate, with broad transparent, scarious margins and brown lateral bands bordering the green center) occurs in Arizona, New Mexico, and Colorado. In typical *J. interior* the perianth is 3-4 mm long (4-5 mm in vars. *arizonicus* and *neomexicanus*) and equals the capsule, rather than exceeding it. Ohio and Indiana westward to Alberta, Wyoming, and Arizona.

Forage Value

Reports vary, but generally considered to be fair to good for all classes of stock.

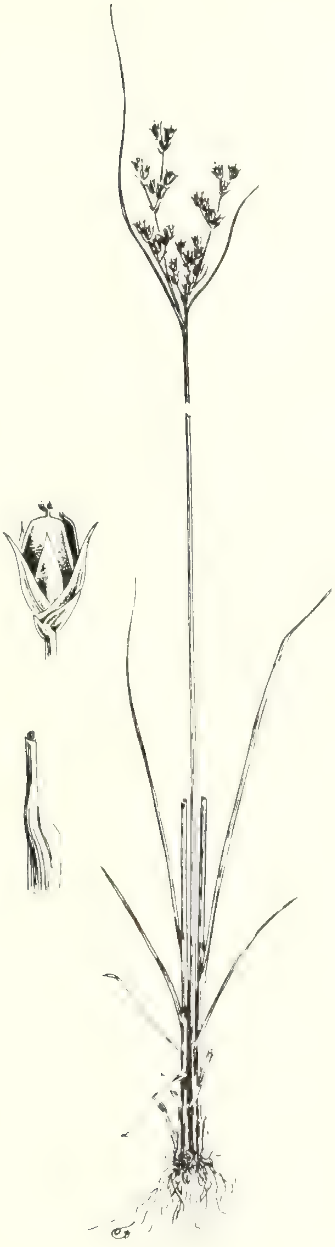


Plate 5. JUNCUS INTERIOR

6. **Juncus confusus** Coville

Juncus confusus Coville, Proc. Biol. Soc. Wash. 10: 127. 1896.

Sparingly tufted perennial; *stems* slender, 3-5 dm high; *leaves* basal, one-half to two-thirds the length of the stems, the channeled blades almost filiform, not septate, the auricles membranaceous, white, rounded, scarcely 1 mm long; *inflorescence* compact, rather few-flowered, 1-2 cm long, the lowest bract filiform, mostly several times as long as the inflorescence; *perianth segments* 3.5-4 mm long, ovate-lanceolate, acuminate, subequal, little if at all exceeding the capsule, fuscous with a broad greenish central stripe, broadly scarious-margined to the blunt or short-pungent apex; *stamens* 6, the anthers about 0.6 mm long, much shorter than the filaments; *capsule* broadly oblong, equaling to slightly shorter than the perianth, completely three-celled, triquetrous and retuse at the apex; *seeds* about 0.5 mm long, obliquely obovoid to broadly ellipsoid, short-apiculate at both ends, areolate, the longitudinal ridges generally prominent.

Common to very common in moist, grassy habitats, mostly at lower elevations. British Columbia and eastern Washington southward to California and Arizona.

Forage Value

This appears to have the highest value, on the average, of any of the *J. tenuis* group, perhaps because it is much more plentiful, on the whole, than any of its near allies. Usually it is grazed considerably more by cattle and horses than by sheep, although in the Bridger National Forest, Wyoming, it is reported to have very high forage value for all types of stock. In North Park, Routt National Forest, Colorado, it is used extensively for hay.

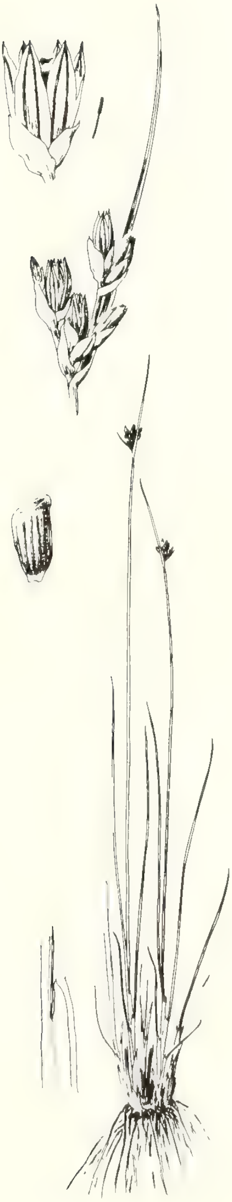


Plate 6. JUNCUS CONFUSUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

7. **Juncus brachyphyllus** Wieg.

Juncus brachyphyllus Wieg., Bull. Torrey Club 27: 519. 1900.

Cespitose perennial; *stems* rather stout, 3-5 dm high; *leaves* basal, the blades short, flattened, 1-2 mm wide, one-fourth to one-third the length of the stem, the conspicuous auricles membranaceous; *inflorescence* 2-6 cm long, cymose, loosely many-flowered, usually somewhat exceeded by the involucral bract; *perianth* 4.5-5.5 mm long, the segments long-acuminate, pale greenish to straw-colored, the inner rather broadly scarious-margined, the outer longer and narrowly scarious-margined below the long-pungent apex, conspicuously exceeding the capsule; *stamens* 6, the anthers 0.5-0.8 mm long, shorter than the filaments; *capsule* narrowly oblong, firm, slightly triquetrous and obtuse to retuse at the apex, about equaling the inner perianth segments; *seeds* obliquely ellipsoid, about 0.5 mm long, very short-apiculate at each end, faintly areolate.

Infrequent to rare in moist habitats at lower elevations. Eastern Washington and Oregon, California, eastward to Idaho, New Mexico, Texas, and Arkansas.

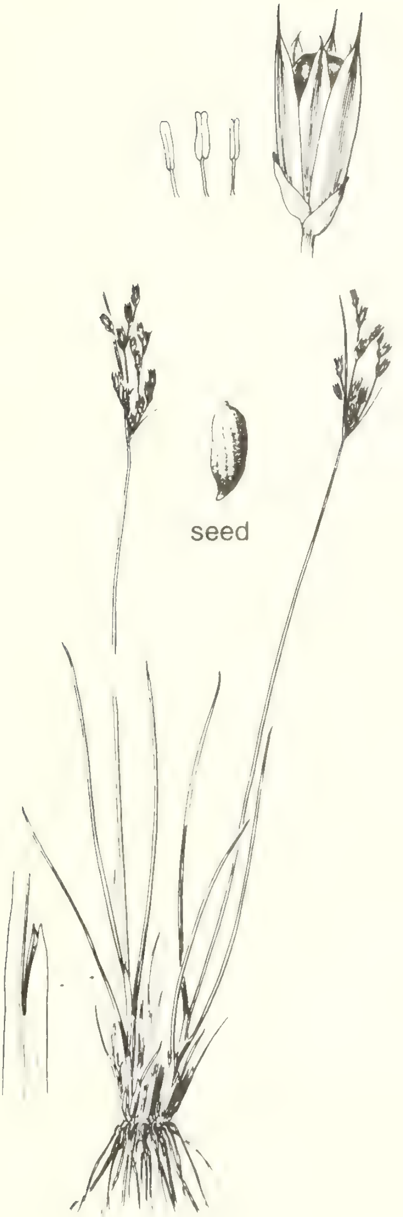


Plate 7. JUNCUS BRACHYPHYLLUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

8. Juncus vaseyi Engelm.

Juncus vaseyi Engelm., Trans. Acad. Sci. St. Louis 2: 448. 1866.

Densely tufted perennial; *stems* stiffly erect, 1.5-8 dm high; *leaves* basal, the blades nearly terete, very slightly channeled, not septate, about 1 mm wide, the auricles short (less than 1 mm long), rounded, membranaceous; *cyme* green or greenish, 15-40 mm long, the 15-50 flowers rather crowded, subtended by a stiff, erect bract 1-8 cm long; *perianth* 3.5-4.5 mm long, the segments greenish, rigid, subequal, the inner rather blunt with broad, scarious margins, the outer lanceolate, acute, appressed; *stamens* 6, the anthers (about 0.8 mm long) about equaling the filaments; *capsule* oblong-cylindric, obtuse, greenish, 4.5-6 mm long, exceeding the perianth, three-celled; *seeds* slenderly fusiform, 1-1.5 mm long, pale brown with white tails at each end almost as long as the body.

Rare to occasional on moist shores, thickets, etc. Quebec to British Columbia, southward to New York, Michigan, Illinois, Idaho, Utah, and Colorado.

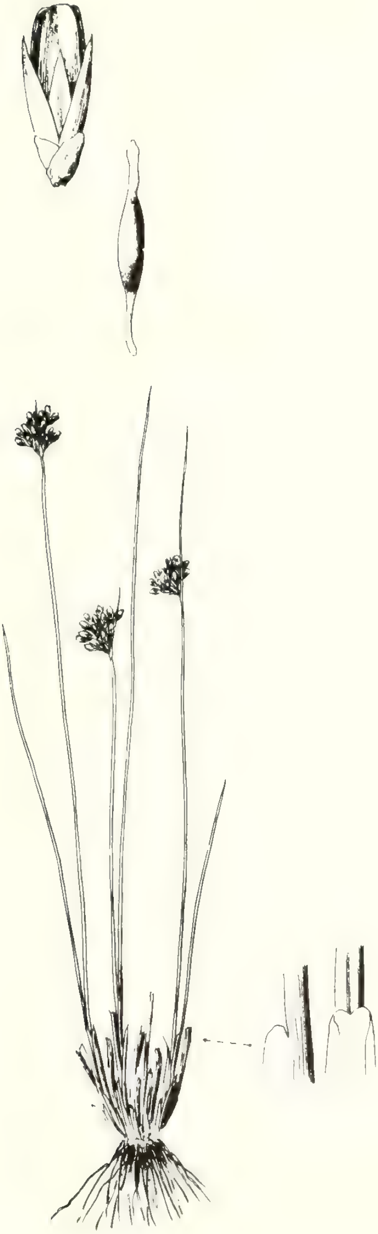


Plate 8. JUNCUS VASEYI

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

2. § GENUINI

9. **Juncus effusus** L. var. **compactus** Hoppe

Juncus effusus var. *compactus* Hoppe in Lejeune & Court., Comp. Fl. Belge 2: 23. 1831.
J. bogotensis var. *compactus* (Hoppe) Farw., Am. Midl. Nat. 10: 206. 1927.
J. effusus var. *caeruleomontanus* St. John, Res. Stud. St. Coll. Wash. 2: 110. 1931.
J. effusus auct. Am., non L.

Stems densely tufted from stout, branching rhizomes, 4.5-12 dm high terete, usually firm, faintly many-striate, 1.5-4 mm in diameter at the top of the sheaths, which are bladeless or with a minute awnlike vestige of the blade, large and rather loose and dull, pale- or chocolate-brown below; *involucral bract* terete and resembling the stem, 7-20 cm long; *inflorescence* appearing lateral, small, compact and dense, 1-4.5 cm in diameter; *perianth segments* subequal, 1.8-2.5 mm long, soft, curved and wrinkled when dry, spreading from the base, the midrib broad and pale, with no conspicuous dark lateral bands, the margins broadly scarious; *stamens* 3 (rarely 6), opposite the outer segments, the anthers scarcely 1 mm long, equaling or shorter than the filaments; *capsule* more or less obovoid, olive-brown, rounded or slightly retuse and sometimes umbonate at the apex, about equaling the perianth; *seeds* broadly ellipsoid, about 0.4 mm long, apiculate and finely reticulate.

Seen only from two counties in Idaho: Benewah County (fairly common on stream bench, Santa Creek, 2,800 ft, Sept. 7, 1954, *V. D. Moss 3* (USFS)), Boise County (wet soil, R. 5 E., T. 6 N., Idaho City, July 11, 1940, *R. J. Davis 2781* (USFS)), and reported by Hitchcock (17) also from Clearwater County. The "*Juncus effusus* L." reported by Booth (2) as "found in swamps and moist places throughout" Montana may be this variety. Newfoundland to Ontario, southward to New York and West Virginia and westward to Michigan, Wisconsin, and (where it may have been introduced) Idaho and Washington; Europe. Several additional varieties occur in eastern North America and on the Pacific coast.

Typical *Juncus effusus* L. is principally a European taxon, being known in North America only from Newfoundland and Prince Edward Island. It and its numerous varieties form an extremely polymorphic complex.

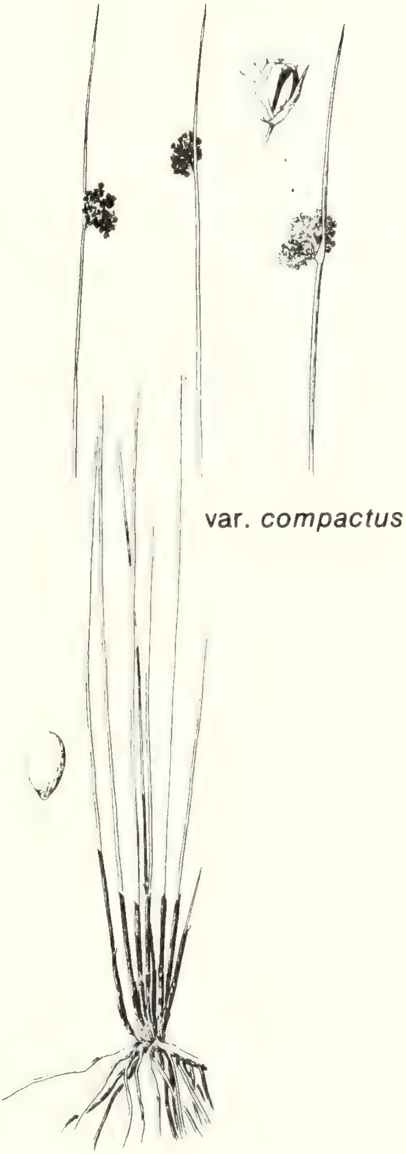


Plate 9. JUNCUS EFFUSUS VAR. COMPACTUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

9a. **Juncus effusus** L. var. **exiguus** Fern. & Wieg.

Juncus effusus var. *exiguus* Fern. & Weig., Rhodora 12: 87. 1910.

Slender densely tufted perennial, 4-6 dm high; *stems* firm and wiry in texture, finely striate, 1-1.5 mm in diameter at the top of the sheaths; *leaves* bladeless, the sheaths moderately firm, pale brownish-rufescent below, the uppermost 9-11 cm long, greenish toward the summit; *involucral bract* terete and appearing like a continuation of the stem, 4-10 cm long; *inflorescence* appearing lateral, loosely fastigiate, 4-5.5 cm long; *perianth* very small (2 mm long), soft, wrinkled and curved when dry, the segments with greenish midrib or tinged with pale brown, bordered with pale brown bands and narrow, scarious margins; *stamens* 3, opposite the outer segments; *capsule* pale-olive-brown, not apiculate, about three-fourths the length of the perianth.

Seen only from southern Arizona: Pinal Peak, Gila County, 7,500 ft (*Smith 14066*) and Santa Catalina Mountains, Pima County (*Thornber 7518*). California to southern Arizona.

Forage Value

We have no reports from our area but in California its palatability is said to be low. Muskrats feed on the tender shoots and rootstocks extensively.

9b. **Juncus effusus** L. var. **brunneus** Engelm.

Juncus effusus var. *brunneus* Engelm., Trans. Acad. Sci. St. Louis 2: 491. 1868.

J. effusus var. *hesperius* Piper, Contrib. U.S. Natl. Herb. 11: 180. 1906.

Tall and rather slender, cespitose perennial, 5-10 dm high; *stems* rather stiff, inconspicuously many-striate, 1.2-2.4 mm in diameter at the top of the sheaths; *leaves* reduced to bladeless sheaths, these loose, membranaceous, reddish-brown at the base, the uppermost much paler and greenish-drab toward the summit, mostly 10-15 cm long; *involucral bract* terete, appearing like a continuation of the stem, 7-15 cm long; *inflorescence* appearing lateral, small (1-3 cm in diameter), varying from dense to rather loose; *perianth* 2.4-2.9 mm long, soft, wrinkled when dry, the segments with very slender greenish midrib bordered by dark brown bands and nearly obsolete scarious margins; *capsule* slightly longer than or about equaling the perianth.

This variety has been collected in Arizona near Baker Butte, Coconino County, 7,500 ft (*Darrow 3264*) and in the Rincon Mountains, Pima County, 7,500 ft (*Neally 158*). California to Arizona.

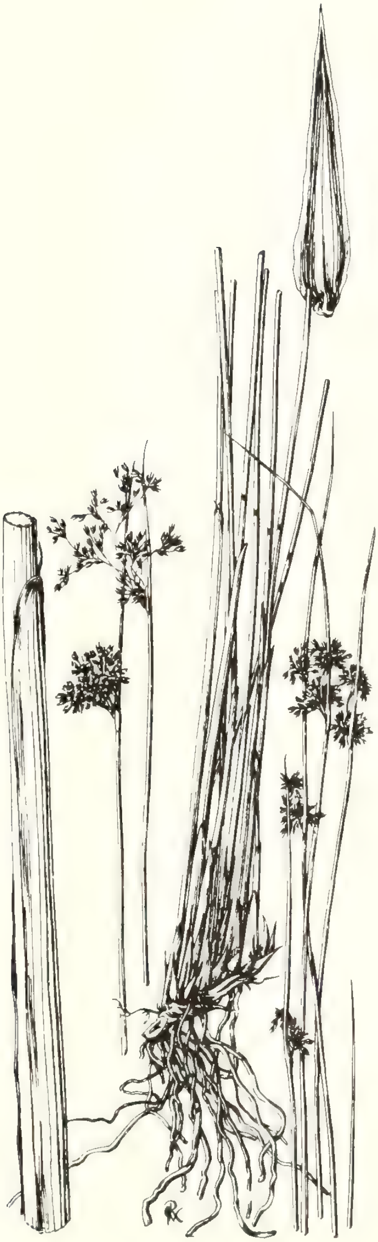


Plate 9b. JUNCUS EFFUSUS VAR. BRUNNEUS

(From Mason: Flora of the California Marshes)

10. Juncus filiformis L.

Juncus filiformis L., Sp. Pl. 326. 1753.

Stems arising, singly or in tufts, from creeping rhizomes, terete, filiform, rarely over 1 mm thick at the top of the sheaths, 0.5-6 dm high; *leaves* reduced to tight basal sheaths, the uppermost usually with a bristle-like vestige of a blade; *inflorescence* appearing lateral, the involucral bract terete, erect, sharp-pointed, from half as long as the stem to exceeding it; *cyme* few-flowered, with usually simple branches 0.2-2 cm long, or nearly capitate; *flowers* greenish, 3-4 mm long, the perianth segments lanceolate, subequal, mostly slightly exceeding the capsule; *stamens* 6, about half as long as the perianth, the anthers 0.4-0.6 mm long, much shorter than the filaments; *capsule* broadly ovoid to obovoid, firm, three-celled, barely pointed at the apex; *seeds* obliquely oblong-ellipsoid, 0.5 mm long, apiculate at each end, faintly reticulate.

Occasional to frequent on wet shores or in mountain meadows and marshes, from lowlands to about 9,000 ft elevation. Labrador to Alaska, southward to Maine, New York, uplands of Pennsylvania and West Virginia, Michigan, Minnesota, Colorado, Utah, and Oregon; Eurasia.

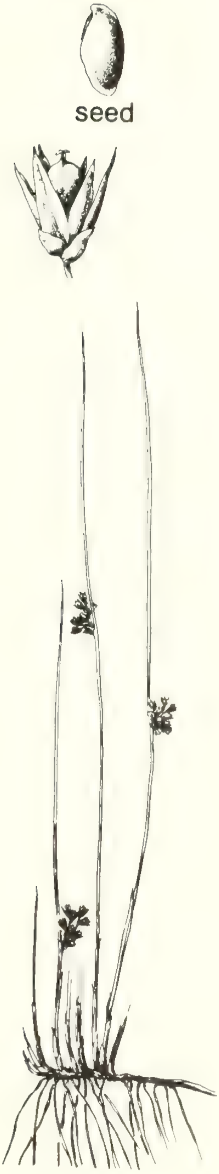


Plate 10. JUNCUS FILIFORMIS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

11. **Juncus drummondii** E. Mey.

Juncus drummondii E. Mey in Ledeb., Fl. Ross. 4: 235. 1853.

Strongly tufted perennial; *stems* numerous, 1-3.5 dm high, terete, slender, from matted rootstocks; *basal sheaths* short, straw-colored, 2-6 cm long, bladeless or the inner tipped with a bristle-like blade, 2-10 mm long; *involucral bract* erect, sharp-pointed, appearing like a continuation of the culm, mostly 1.5-3 cm long; *flowers* 1-3 (rarely 4-5), rather closely aggregated, each subtended by two brownish, membranaceous bractlets; *perianth segments* lanceolate-attenuate, subequal, 5-7 mm long, green with broad, scarious, brown margins; *stamens* 6, little more than half the length of the perianth, their anthers much longer than the filaments; *capsule* oblong, three-celled, blunt and more or less retuse at the apex, about equaling the perianth; *seeds* narrowly obovoid, about 2 mm long, finely striate, long-caudate at each end.

Very common in most of our range on alpine tundra, in subalpine meadows, streambanks, talus slopes and ridges, but in Arizona known only from San Francisco Peaks (11,500 ft), Coconino County. Alaska to California, eastward to Alberta, western Montana and New Mexico.

Forage Value

Highly variable according to numerous reports, ranging from 10 percent to 80 percent, in some areas eaten readily by cattle and horses, very little by sheep and goats, in others 80 percent grazed by sheep. Since it is a long-persistent alpine species its palatability doubtless varies with the season and would be especially dependent upon the availability of other, more succulent fodder.

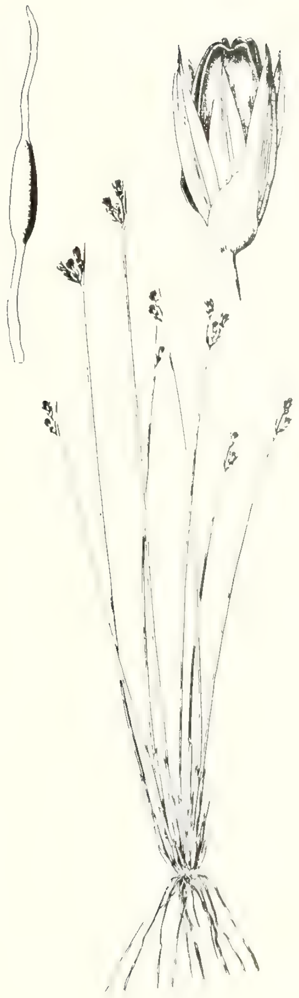


Plate 11. JUNCUS DRUMMONDII

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

11a. **Juncus drummondii** var. **subtriflorus** (E. Mey.) C. L. Hitchc.

Juncus drummondii var. *subtriflorus* (E. Mey.) C. L. Hitchc., Vasc. Plants Pac. NW. 1: 193. 1969.
J. compressus var. *subtriflorus* E. Mey., Linnaea 3: 368. 1828.
J. subtriflorus (E. Mey.) Coville, Contrib. U.S. Natl. Herb. 4: 208. 1893.
J. drummondii var. *longifructus* St. John, Proc. Biol. Soc. Wash. 44: 29. 1931.
J. drummondii var. *longifructus* f. *davisonii* St. John, Proc. Biol. Soc. Wash. 44: 30 1931.
J. pauperculus Schwarz in Fedde, Rep. Sp. Nov. 64: 26. 1961.

Differing from typical *J. drummondii* in having the mature capsule usually at least 1 mm longer than the perianth, and the perianth generally somewhat shorter (4-8, usually 5-6, mm long, compared to 6-7 mm in var. *drummondii*).

Reported from Idaho, and apparently occurring sporadically farther east; seen from Montana (Bitterroot Mountains, 7,200 ft, Missoula County, *Stickney & Lackschewitz 3473* (USFS), and Colorado (Crown Point, 11,120 ft, Larimer County, *T. May 135* (CS)).

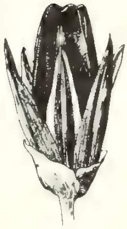


Plate 11a. JUNCUS DRUMMONDII VAR. SUBTRIFLORUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

12. **Juncus parryi** Engelm.

Juncus parryi Engelm., Trans. Acad. Sci. St. Louis 2: 446. 1866.
J. drummondii var. *parryi* (Engelm.) M. E. Jones, Bull. Univ. Mont. Biol. 15: 22. 1910.

Cespitose perennial; *stems* 1-3 dm high, slender, terete, from matted rootstocks; *basal sheaths* more or less brownish, mostly 1-4 cm long, the uppermost bearing a blade which is very slender, grooved at the base, terete above, 3-6 cm long, the lower sheaths bladeless or bearing a bristle-like blade less than 1 cm long, the auricles low, rounded, membranaceous; *involucral bract* terete, sharp-pointed, erect, appearing like a continuation of the stem, mostly 2-4 cm long; *flowers* 1-3, aggregated but inserted singly and subtended by two brownish, ovate, membranaceous bractlets; *perianth segments* 6-9 mm long, sometimes green in the center, mostly tinged with brown, with broad scarious margins, the outer lanceolate, acuminate, the inner slightly shorter and acute to rounded; *stamens* 6, the anthers about 1.5 mm long, much longer than the filaments; *capsule* usually slightly exceeding the perianth, narrowly oblong, acute; *seeds* narrowly ovoid, the body about 0.6 mm long, finely striate, long-tailed at each end.

Frequent to locally common in alpine and subalpine meadows, on streambanks and often on dry, rocky slopes. British Columbia southward to the Sierra Nevada, California, and eastward to the Rocky Mountains from southwestern Alberta and western Montana to Colorado.

We are informed by Mont E. Lewis that *J. parryi* is used as the main indicator species for identifying the *Abies lasiocarpa/Pinus albicaulis* habitat type.

Forage Value

Averaging less than that for the generally more plentiful *J. drummondii,* being generally rated as poor to fairly good, rarely over 50 percent, although reported to be excellent for horses and sheep in the Payette National Forest, Idaho. Elk are said to relish it.

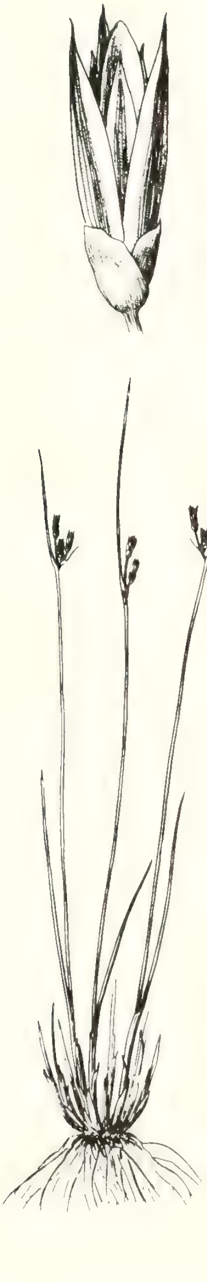


Plate 12. JUNCUS PARRYI

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

13. **Juncus hallii** Engelm.

Juncus hallii Engelm., Trans. Acad. Sci. St. Louis 2: 446. 1866.

Cespitose perennial; *stems* 2-3 dm high, slender, terete; *leaves* basal and on the lower fifth of the stem, the lowest sheaths brownish, bladeless or with a bristle-like blade, the upper blades 5-15 cm long, terete, channelled; *involucral bract* terete, leaf-like, scarcely exceeding the inflorescence; *inflorescence* generally appearing lateral; *flowers* 2-7, closely cymose but obviously pedicellate, subtended by two ovate bractlets; *perianth segments* 4-5 mm long, acute, light brown, scarious-margined, the outer slightly longer than the inner; *stamens* 6, the anthers scarcely 1 mm long, about equaling the filaments; *capsule* oblong-ovoid, triquetrous, clearly retuse at the apex, three-celled, dark brown, equaling or slightly exceeding the perianth; *seeds* oblong-linear, about 1 mm long, finely striate, long-caudate at each end.

Rare or local in mountain meadows in the Rocky Mountains, from southern Montana to Colorado; montane to subalpine.

Forage Value

Fair to good for horses, so it may be of importance in the few areas where it is locally plentiful.

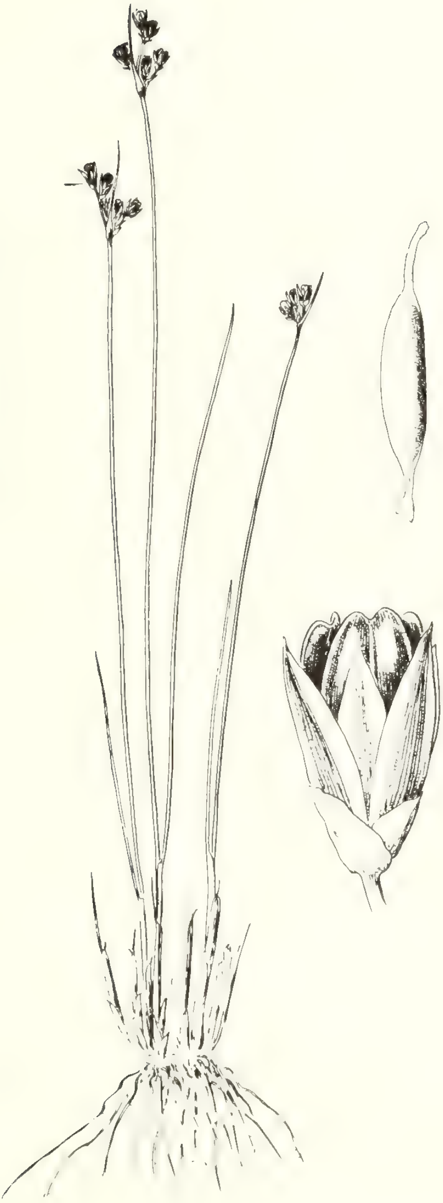


Plate 13. JUNCUS HALLII

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

11. **Juncus balticus** Willd. var. **montanus** Engelm. Wire Rush

Juncus balticus var. *montanus* Engelm., Trans. Acad. Sci. St. Louis 2: 442. 1866.
J. ater Rydb., Fl. Rocky Mts. 151, 1060. 1917.
J. arcticus Willd. ssp. *ater* (Rydb.) Hultén, Kungl. Svenska Vet. Akad. Handl. IV, 8: 524. 1964.
J. balticus auct. Am., non Willd.

Rootstock stout, firm, long-creeping; *stems* in small tufts or scattered, slender, smooth, terete to somewhat flattened, mostly 1-3 dm high, about 1.5 mm in diameter at the base; *sheaths* basal, rather loose, straw-colored to brown, bladeless or sometimes with a filament-like rudiment; *involucral bract* terete, sharp-pointed, erect, appearing like a continuation of the culm, 3-20 cm long; *inflorescence* appearing lateral, congested and usually subcapitate, generally about 1 cm long; *perianth segments* 4-5.5 mm long, lanceolate, acute to short acuminate, with scarious margins, subequal, 3.5-5 mm long; *stamens* 6, the anthers 1.2-2.2 mm long, much longer than the filaments; *capsule* ovoid, acute, mucronulate, from nearly as long as to slightly longer than the perianth; *seeds* obliquely ovoid-ellipsoid, about 0.6 mm long, very finely striate-reticulate, minutely apiculate.

Very common (our most plentiful rush), especially along streams, lake-shores and on alkali flats, from the plains to the alpine zone. Alaska southward to California, Kansas, and Arizona.

Juncus balticus and its varieties comprise an extremely polymorphic complex. Typical *J. balticus* is Eurasian and, although a form occurring on the Pacific Coast from Alaska to California is probably referable to it, it does not otherwise occur in North America.

Forage Value

In spite of the wiry texture of the plants, the varieties of *J. balticus* are, on the whole, among our most important forage plants. Reports on palatability vary enormously, from very low to excellent for all classes of stock, no doubt fluctuating with the season and presence or absence of other fodder. Certainly as forage its value is much higher when young and tender; on the other hand it is in many areas a very important component of the hay crop. The observations of Dr. Joseph Barrell (Flora of the Gunnison Basin, pp. 25-26) on the economic importance of *J. balticus* near Cathedral, Hinsdale County, Colorado, are very pertinent: "To see what the meadows southwest of Cathedral contained, I went one day to a field that had just been mowed, and walked back and forth, sampling the new mown hay. My sampling showed that the two principal "grasses" (to use the names by which they are known among the ranchers) were June-grass (*Deschampsia caespitosa*) and wiregrass (*Juncus balticus*) . . . In passing, it might be of interest to observe (in evidence of the native quality of the meadows) that the ranchers with one accord value most highly *Juncus balticus.* Although the cattle will not eat it in pasture, they will as hay; and the ranchers are agreed that it has no equal for protein content, or perhaps one should say, for protein-forming content. They all would like a greater concentration of it in their meadows, and would like to procure seed to achieve this end. It was here that I suggested that they take a hint from the growing of iris in gardens, plant small sections of root here and there, and let the plantings grow and merge into a pure stand."

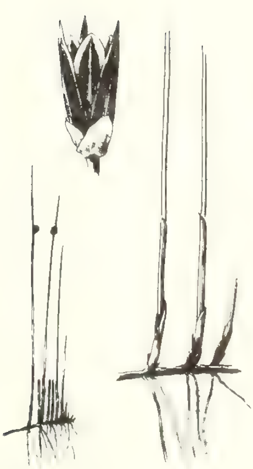


Plate 14. JUNCUS BALTICUS VAR. MONTANUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

14a. Juncus balticus var. **vallicola** Rydb.

Juncus balticus var. *vallicola* Rydb., Bull. Torrey Club 31: 399. 1904.
J. vallicola (Rydb.) Rydb., Fl. Rocky Mts. 152, 1060. 1917.

Very similar to *J. balticus* var. *montanus,* but the stems taller, often to 6 dm high, and stouter, 2-4 mm in diameter at the base; the *inflorescence* diffuse and mostly 5-15 cm long; and the *perianth segments* 5-6 mm long, dark brown-margined, the outer acuminate and about 0.5 mm longer than the inner.

Frequent around lakes and bogs and in marshes, from the plains to submontane. Washington to California, eastward to Montana and Colorado. Transitional forms between this and var. *montanus* are frequent where their ranges overlap.

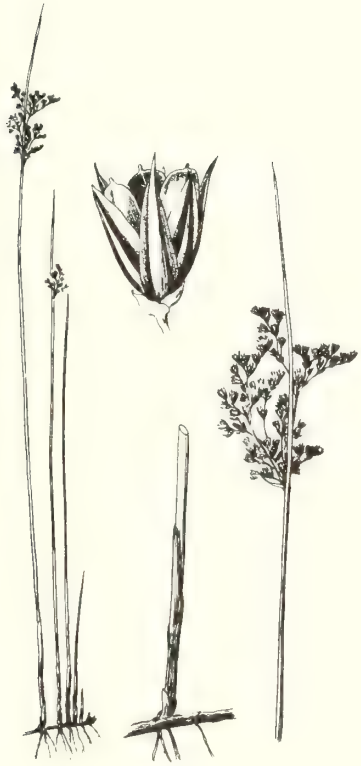


Plate 14a. JUNCUS BALTICUS VAR. VALLICOLA

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

15. **Juncus mexicanus** Willd.

Juncus mexicanus Willd., in Roem. & Schult., Syst. 7: 178. 1829.
J. compressus HBK., Nov. Gen. & Sp. 235. 1815, not Jacq. 1762.
J. balticus var. *mexicanus* (Willd.) Kuntze, Rev. Gen. Pl. 3: 320. 1893.

Perennial, mostly 2-6 dm high; *stems* little if at all tufted, from stout creeping rootstocks, slender, smooth, usually compressed and twisted; *leaves* basal, mostly reduced to bladeless, brown or straw-colored sheaths, but some with terete blades 5-20 cm long, the auricles short, rounded, somewhat cartilaginous; *involucral bract* 3-15 cm long, terete, erect, appearing like a continuation of the culm; *inflorescence* appearing lateral, 2-8 cm long, generally loosely 5- many-flowered; *perianth segments* greenish or straw-colored with broad, scarious margins, 4-5 mm long, lanceolate, acuminate, subequal; *stamens* 6, the anthers 1.4-1.6 mm long, much longer than the filaments; *capsule* ovoid, brown, mucronate, about as long as the perianth; *seeds* oblong-obovoid, irregularly reticulate.

In our area so far known only in Arizona, where it is frequent, especially on somewhat saline soils, from 3,000 to 7,000 ft, and Santa Fe County, New Mexico. California and Mexico, eastward to New Mexico and Texas.

3. § THALASSII

16. Juncus acutus L. var. **sphaerocarpus** Engelm.

Juncus acutus var. *sphaerocarpus* Engelm., Rep. U.S. Geol. Surv. W. 100 Merid. 6: 376. 1878.
J. acutus auct. Am., non L.

Stout, rigid, densely cespitose perennial, 6-12 dm high; *stems* terete, pungent; *leaves* all basal, terete, nearly as long as the stems, the sheaths inflated, brownish, the auricles from scarcely developed to several mm high, cartilaginous; *involucral bract* foliose, stout, spinescent, 5-15 cm long; *inflorescence* paniculate, the branches very unequal, 5-20 cm long; *flowers* 2-4 in small clusters, without bracteoles; *perianth segments* 2-4 mm long, pale brown, glossy, indurate, the outer broadly lanceolate, obtuse to acutish, with a broad, scarious margin, the inner shorter, rounded to retuse at the scarious-margined apex; *stamens* 6, nearly equaling the perianth, the anthers 1.25-1.75 mm long, much longer than the filaments; *capsule* subglobose, obtuse, mucronate, about 5 mm long, the valves very rigid, much exceeding the perianth, *seeds* obliquely obovoid, acute to slightly tailed at each end, finely reticulate.

In our area known only from Arizona where it is occasional in saline habitats. Southern California, Baja California eastward to southern Nevada, Arizona, and Puebla, Mexico.

Typical *J. acutus* is European.

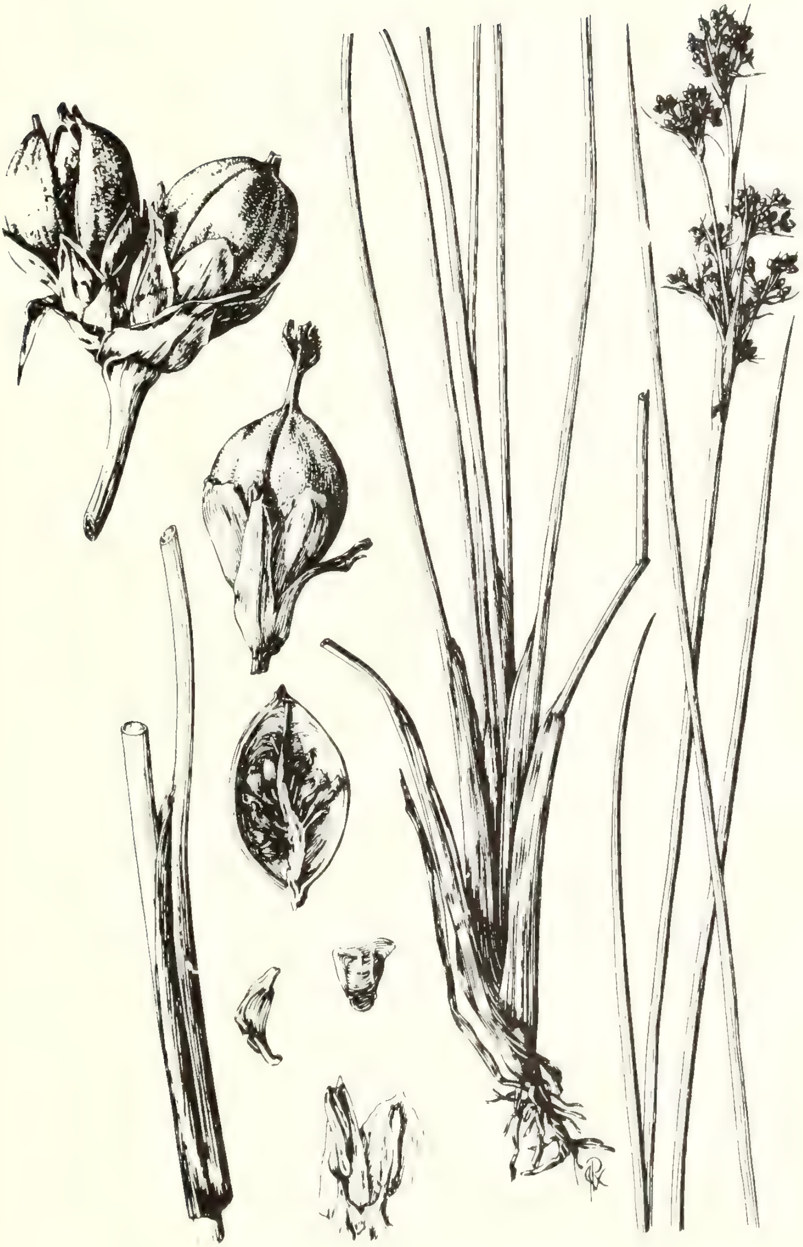


Plate 16. JUNCUS ACUTUS VAR. SPHAEROCARPUS

(From Mason: Flora of the California Marshes)

17. **Juncus marginatus** Rostk.

Juncus marginatus Rostk., Monog. Junc. 38, pl. 2, f. 3. 1801.
J. marginatus var. *paucicapitatus* Engelm., Trans. Acad. Sci. St. Louis 2: 455. 1866.

Cespitose perennial, from short, thick, often knotty rhizomes; *stems* slender, erect, more or less compressed, 1.5-7 dm high, 1-2.5 mm thick at the base; *leaves* flat, soft, the basal ones 0.4-2 dm long, 1-5 mm wide, the blades with three prominent veins, the sheaths with rounded, scarious auricles; *involucral bract* shorter than the inflorescence, often inconspicuous; *inflorescence* cymose, 1-10 cm long, open or somewhat compact, with 2-40 glomerules, 4-6 mm in diameter, of 2-12 flowers each, the glomerules subtended by lance-attenuate bracts; *perianth* 2-3.5 mm long, the reddish-brown outer segments sharply acute, slightly shorter than the ovate to oblong, blunt to mucronate inner segments, with green center separated from the hyaline margin by a brown band; *stamens* 3, slightly shorter than the outer perianth segments, the anthers reddish, much shorter than the filaments, quickly shriveling; *capsule* obovoid, thin-walled, rounded to truncate or retuse at the apex, beakless, almost three-celled, dull, lusterless, equaling the perianth; *seeds* oblong-ovoid, brown, 0.5 mm long, many-ribbed, apiculate at both ends.

Rare in swampy places on plains and in piedmont valleys in Colorado and Arizona. Nova Scotia and Maine, southward to Florida and westward to Michigan, Missouri, Texas, Colorado, Arizona, and California.

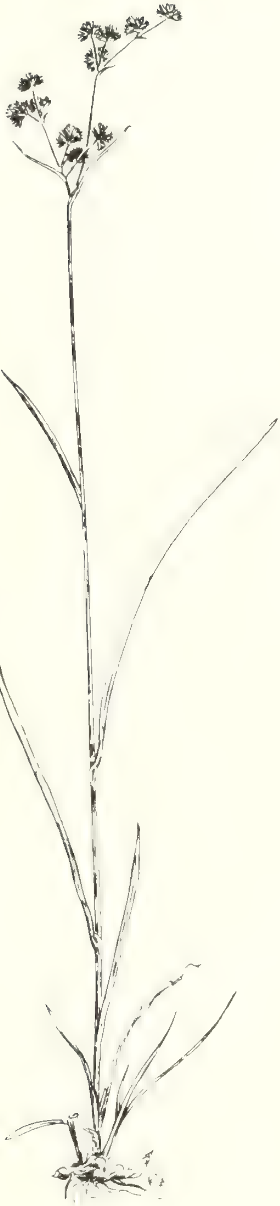


Plate 17. JUNCUS MARGINATUS

17a. **Juncus marginatus** var. **setosus** Coville

Juncus marginatus var. *setosus* Coville, Proc. Biol. Soc. Wash. 8: 124. 1893.

J. setosus (Coville) Small, Fl. SE. U.S. 258. 1903.

Very similar to var. *marginatus* except that the inner perianth segments are lance-attenuate and subulate-tipped and the capsule is glossy. Actually this is closer to the eastern *J. biflorus* Ell. in its glossy capsule and generally fewer-flowered heads but intermediates are so plentiful between var. *setosus*, var. *marginatus* and *J. biflorus* that, rather than proposing a transfer of var. *setosus* to varietal status under *J. biflorus*, it seems preferable to treat the latter as *J. marginatus* var. *biflorus* (Ell.) Engelm.

This is the commoner form in Arizona, the type specimen having come from the Santa Catalina Mountains (*Pringle*, June 4, 1882).

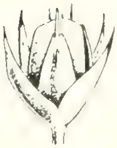


Plate 17a. JUNCUS MARGINATUS VAR. SETOSUS

18. Juncus regelii Buch.

Juncus regelii Buch. in Engl., Bot. Jahrb. 12: 414. 1890.
J. jonesii Rydb., Fl. Rocky Mts. 153 and 1061. 1917.

Perennial from stout, stoloniferous rootstocks; *stems* single or tufted, slender and somewhat flattened, 1-6 dm high; *leaves* equaling or exceeding the stems, the sheaths with narrow membranaceous margins, the auricles not developed or poorly so, the blades flat and grass-like, 10-15 cm long, 2-4 mm wide; *involucral bract* 1-4 cm long; *inflorescence* terminal, composed of 1-5 globose to hemispherical heads, 10- 30-flowered, 8-20 mm in diameter; *perianth segments* 4-6 mm long, broadly lanceolate, papillose-roughened, dark brown with a broad greenish midstripe, the inner slightly shorter, broader, with a wider scarious margin, and more blunt; *stamens* 6, the anthers 1-1.5 mm long, about equaling the filaments; *capsule* oblong-ovoid, truncate to retuse, about equaling the perianth; *seeds* 1.2-1.8 mm long, narrowly ellipsoid, reticulate, long-tailed at both ends.

Occasional in mountain meadows and along wet trailsides in Montana, Idaho and Utah; a single collection seen from Wyoming (Tower Falls, Yellowstone National Park, *H. S. Conard 1705* (RM)); montane to subalpine. Southern British Columbia southward to northern California, and eastward to Montana, Utah, and Wyoming.

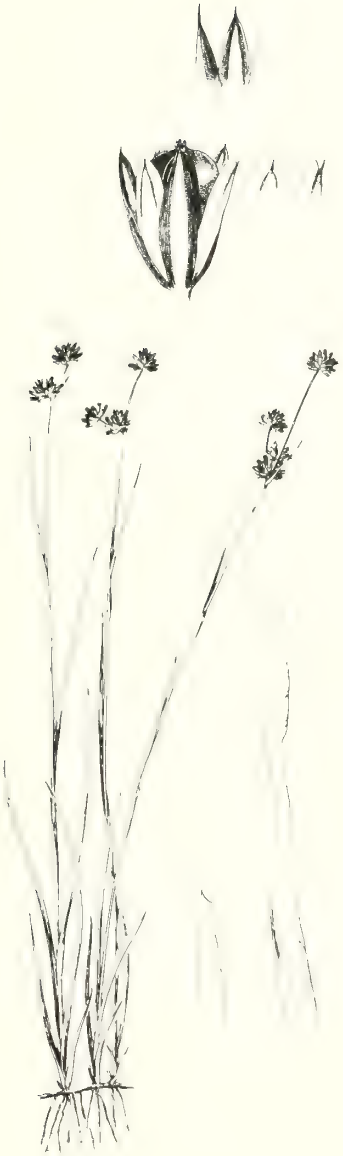


Plate 18. JUNCUS REGELII

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

19. **Juncus longistylis** Torr.

Juncus longistylis Torr., Bot. Mex. Bound. 223. 1859.

Loosely tufted, rhizomatous perennial; *stems* slender, somewhat compressed, 2-6 dm high; *leaves* mostly basal (the cauline 1-3), one-third to one-half the length of the stem, the sheaths with distinct, obtuse to truncate auricles (except in var. *scabratus*) 0.5-2 mm long, the blades grass-like, dorsiventrally flattened, 1-3 mm wide; *involucral bract* membranaceous, 1-2 cm long; *heads* 1-8, discrete or more or less aggregated, 3- 12-flowered; *perianth segments* mostly 5-6 mm long, broadly lanceolate, smooth or minutely roughened, brown with a broad greenish midstripe and broad scarious, whitish margins, the inner slightly longer than the outer; *stamens* 6, the anthers 1.2-2 mm long, usually much longer than the filaments; *capsule* oblong, rounded to truncate and often retuse, slightly shorter than the perianth; *seeds* obliquely oblong, 0.4-0.5 mm long, conspicuously striate, slightly apiculate at each end.

Frequent to occasional in moist habitats; montane to submontane. British Columbia southward to California and northern Arizona and eastward to Ontario, Nebraska, Colorado, and New Mexico.

Forage Value

From good to very good for cattle and horses, apparently much less for sheep as a rule, but often reported as very palatable to all classes of stock.

19a. **Juncus longistylis** var. **scabratus** F. J. Herm.

Juncus longistylis var. *scabratus* F. J. Herm., J. Wash. Acad. Sci. 30: 218. 1940.

Similar to var. *longistylis* except in having the vegetative parts, particularly the apices of the leaves and the pedicels, strongly scabrous and the auricles tending to be prolonged, free and acute.

Known only from Arizona, where it is the commoner form, especially in the southern half of the State.

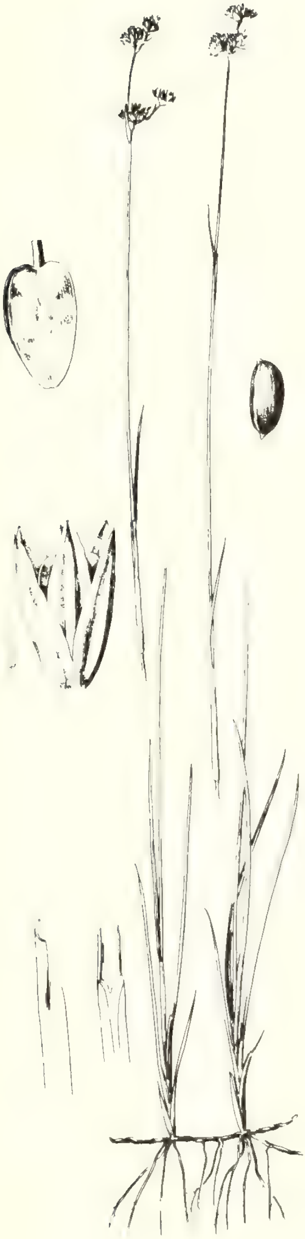


Plate 19. JUNCUS LONGISTYLIS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

20. **Juncus macrophyllus** Coville

Juncus macrophyllus Coville, Univ. Calif. Publ. Bot. 1: 65. 1902.
J. canaliculatus Engelm., Bot. Gaz. 7: 6. 1882, not Liebm. 1850.

Cespitose perennial; *stems* 2-9 dm high, rather stiff, subterete but somewhat compressed; *leaves* pale green, somewhat channeled, the basal striate, from equaling to about half the length of the stems, 1.5-3 mm wide, the cauline 1-3, their blades flat but rather thick and pungent, mostly 8-15 cm long, the sheaths scarious-margined with auricles 1.5-3 mm long; *inflorescence* loosely paniculate, the heads 8-25, 3- 5-flowered; *perianth segments* green, with brownish or reddish tinge, ovate, acute to obtuse, hyaline-margined, 5-6 mm long, the outer distinctly shorter than the inner; *stamens* 6, half the length of the segments, the anthers much longer than the filaments; *capsule* short-obovoid, with a short beak, much shorter than the perianth; *seeds* obliquely obovoid, about 0.5 mm long and about 20-ribbed, the reticulations lineolate.

Known in our area only from Arizona (Yavapai, Maricopa and Pinal Counties), where it is rare on damp slopes below 5,500 ft. Southern California to Arizona, and Baja California.

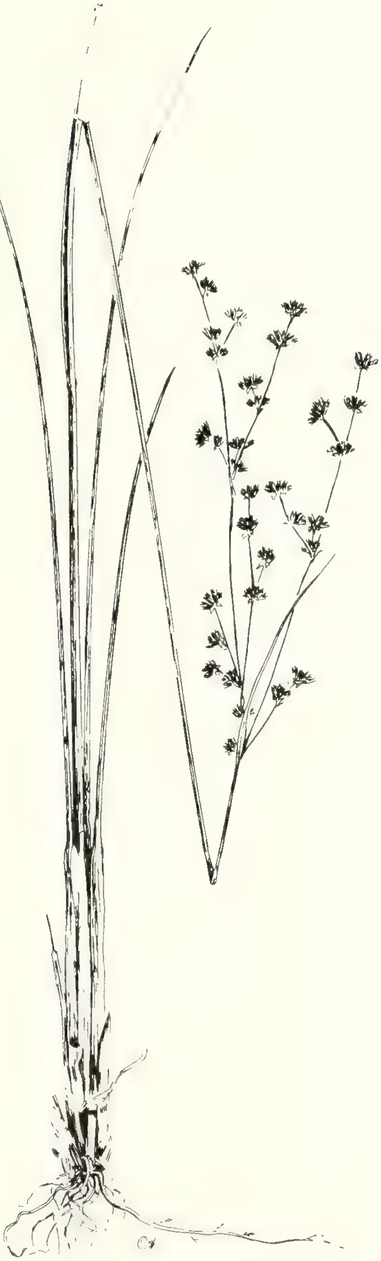


Plate 20. JUNCUS MACROPHYLLUS

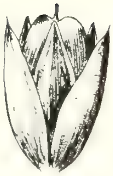
21. Juncus covillei Piper var. **obtusatus** (Engelm.) C. L. Hitchc.

Juncus covillei var. *obtusatus* (Engelm.) C. L. Hitchc., in Hitchcock *et al.*, Vasc. Plants Pac. NW. 1: 193. 1969.

J. obtusatus Engelm., Trans. Acad. Sci. St. Louis 2: 495. 1868, not Kit. 1863.

Cespitose perennial from creeping rootstocks; *stems* 0.5-2.5 dm high, slightly flattened; *leaves* grass-like, mostly basal, flat, 2-3 mm wide, the junction of the sheath and the blade inconspicuous, usually without auricles, about equaling the stems, cauline leaves 1-2, or sometimes none; *inflorescence* paniculate, of 1-6(8) heads, mostly 3- 7-flowered, the bracts and peduncles roughened; *perianth segments* 3-4 mm long, subequal, ovate-oblong, pale brown, broadly scarious-margined, the center minutely papillate-roughened, the outer rounded to acute and short-mucronate, the inner usually obtuse or acutish; *stamens* 6, the anthers 0.9-1.4 mm long, usually slightly longer than the filaments; *capsule* oblong-ovoid, pale brown, obtuse and usually retuse at the apex, only slightly longer than the perianth; *seeds* obliquely cylindric-ovoid, somewhat truncate, faintly reticulate, minutely apiculate at each end.

So far known in our area from only a single collection: steep northeast slope, finger-ridge of Boulder Peak above Nelson Lake, 8,100 ft, Bitterroot Mountains, Ravalli County, Mont., Aug. 1, 1971, *K. H. Lackschewitz 3123* (USFS). Washington to California, eastward to Idaho and western Montana.



var. *obtusatus*

seed

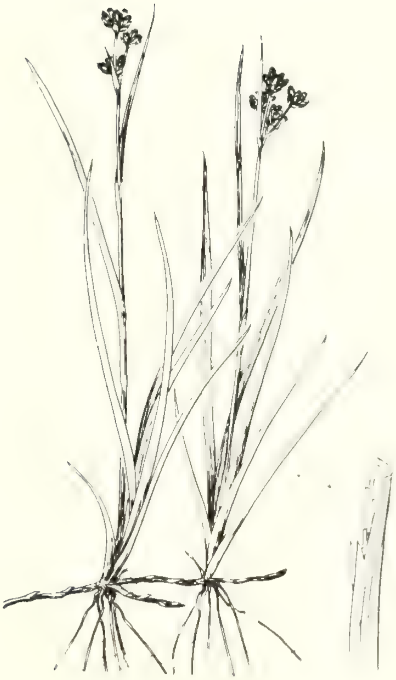


Plate 21. JUNCUS COVILLEI VAR. OBTUSATUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

22. Juncus bryoides F. J. Herm.

Juncus bryoides F. J. Herm., Leafl. West. Bot. 7: 117. 1948.
J. triformis var. *uniflorus* Engelm., Trans. Acad. Sci. St. Louis 2: 493. 1868, in part.

Diminutive annual, 5-15 mm high; *leaves* 1.5-4 mm long, one-third the length of the peduncles or less, the sheaths 0.5-1.5 mm long very broadly hyaline margined, irregular and variable, generally as wide as long, more or less equaling the triquetrous to setaceous-canaliculate blades; *peduncles* 1-25, erect or ascending, filiform; *head* 0.75-1.25 mm wide, one-flowered; *bracts* 2 (occasionally only one), from 0.5-0.9 mm long, ovate to lanceolate, blunt to acuminate, hyaline, generally appressed, sometimes ascending to spreading, sessile to slightly clasping; *perianth* closely appressed to the capsule, tulip-like in appearance, the tips of the perianth segments incurved so that the capsule is usually nearly surrounded; *perianth segments* 1.5-2 mm long, the outer slightly exceeding the inner, about 0.5 mm wide, elliptic-oblong, abruptly acuminate, very thin and broadly hyaline-margined, the midrib and center wine-red, darker toward the tip; *stamens* 3, 0.4-0.7 mm long, the anthers (0.1-0.2 mm) shorter than the filaments (0.3-0.5 mm); *capsule* elliptic-oblong to almost spherical, 1.25-2 mm long, from three-fourths the length of to almost equaling the perianth, brownish-red, the apex obtuse; *seeds* turbinate, 0.35-0.40 mm long, smooth, minutely apiculate.

Known in our area from two collections only: boggy place midway between Salt Lake City and Park City, Wasatch Mountains, Utah, about 7,000 ft, July 2, 1908, *I. D. Cardiff* (NY); and, spring-fed sandstone ledges, Douglas Mt., 7,500 ft, Whisky Springs Ranch, 4 mi above Greystone on Zenobia Peak Road, Moffat County, Colo., June 25, 1965, *W. A. Weber 12561* (COLO; CS; US; USFS). California (where occasional to frequent), Utah and Colorado.

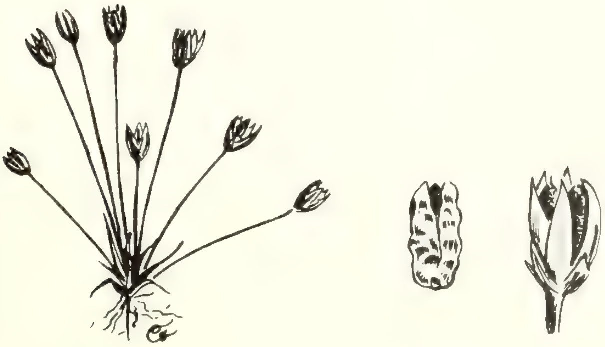


Plate 22. JUNCUS BRYOIDES

5. § ALPINI

23. **Juncus biglumis** L.

Juncus biglumis L., Sp. Pl. 328. 1753.

Loosely tufted, very slender perennial; *stems* erect, 2.5-10(15) cm high, nearly terete; *leaves* 1-5, basal, shorter than the stem, the sheaths prolonged into short, inconspicuous auricles, the blades erect or ascending, 2-7 cm long, about 1 mm thick, terete or nearly so (imperfectly septate, the septa not externally evident); *involucral bract* foliaceous, erect, green with brown margins to blackish-purple, usually exceeding the inflorescence; *inflorescence* a single head of 1-2 (rarely 3 or 4) flowers; *perianth segments* 3 mm long, subequal, oblong, obtuse, from brown to blackish-purple; *stamens* equaling the perianth, the anthers shorter than the filiform filaments; *capsule* trigono-cylindric, retuse, imperfectly three-celled, exceeding the perianth, generally pale with dark-purplish valve margins; *seeds* about 1 mm long, fusiform-ovoid, short-caudate at each end.

Rare in wet gravel and open, rocky slopes in the alpine zone, in Colorado, Wyoming, and Montana. Greenland to Alaska, southward to British Columbia, Alberta, Montana, and Colorado; Eurasia.

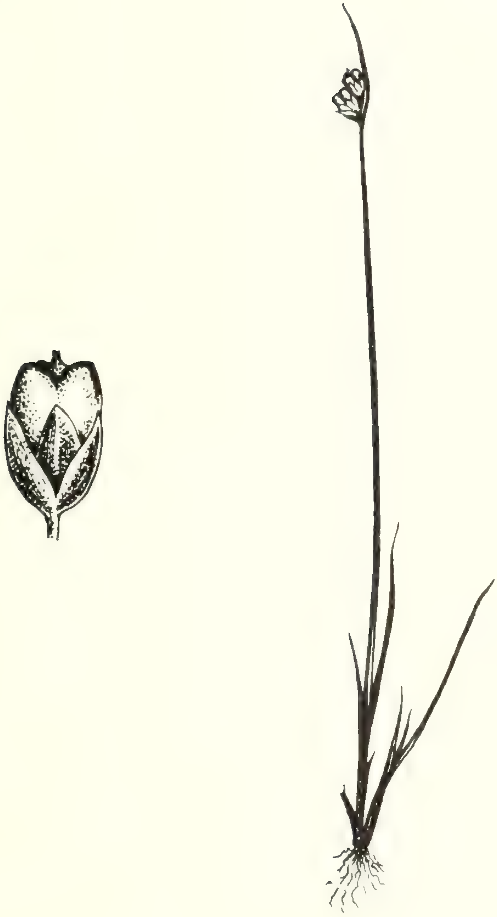


Plate 23. JUNCUS BIGLUMIS

24. **Juncus albescens** (Lange) Fern.

Juncus albescens (Lange) Fern., Rhodora 26: 202. 1924.
J. triglumis var. *albescens* Lange, Conspect. Fl. Groenl. 123. 1880.
J. triglumis auct. Am., not L.

Densely cespitose perennial; *stems* terete, filiform, erect, 3-15(25) cm high; *leaves* basal, 2-10 cm long, filiform, usually less than half the length of the stems, the sheaths greenish-brown, auriculate, the blades filiform, terete, (imperfectly septate, the septa not externally evident), with blunt callous tips; *involucral bracts* (2) brownish, divergent, the lowest about equaling or slightly exceeding the inflorescence, spathiform, obtuse; *inflorescence* of a single 2- 3(5)-flowered head; *perianth segments* 3-5 mm long, oblong-lanceolate, obtuse, subequal, 3-5 mm long, pale brown, whitish or pink-tinged; *stamens* 6, from subequaling the perianth to as much as 1.5 mm shorter, the anthers 0.6-1 mm long, much shorter than the filaments; *capsule* trigonous-cylindric, obtuse, mucronate, about equaling the perianth; *seeds* oblong-fusiform, 1.3-1.7 mm long, the papery covering reticulate, the broad-based white tails shorter than the body.

Rare to frequent or locally fairly common in boggy alpine areas, in Montana, Idaho, Utah, and Colorado. Greenland to Alaska, southward to Quebec, Montana, Utah, and Colorado.

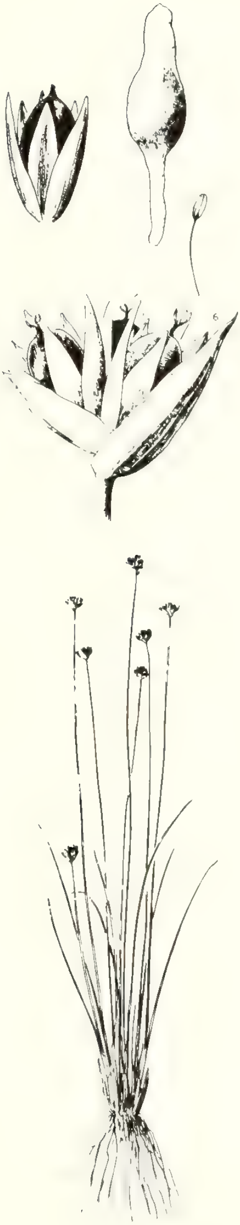


Plate 24. JUNCUS ALBESCENS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

25. **Juncus castaneus** J. E. Smith

Juncus castaneus J. E. Smith, Fl. Brit. 1: 383. 1800.

Strongly stoloniferous perennial; *stems* 1-3(4) dm high, solitary, stiff, erect, leafy; *leaves* erect, (imperfectly septate, the septa not externally evident), the outer sheaths short, loose, the inner clasping, not auriculate, their blades tapering from an involute-tubular base to a slender, channeled, acutish apex; *lower involucral bract* leaf-like, from equaling to much overtopping the inflorescence; *inflorescence* strict, the heads 1-3 (rarely more), usually aggregated, 2- 12-flowered; *perianth segments* dark brown, in anthesis about 5-6 mm long, becoming 6-10 mm long with the fruit, the outer linear-lanceolate, acute, usually slightly exceeding the narrow, obtuse inner series; *stamens* 6, equaling the perianth, the anthers about 1 mm long, shorter than the filaments; *capsule* castaneous to purple-black, narrowly oblong, tapering to an acute apex, imperfectly three-celled, conspicuously exserted; *seeds* very slenderly fusiform, 2.5-4 mm long, contracted at each end into a tail two to three times the length of the body.

Occasional to frequent in subalpine and alpine bogs and meadows, on streamsides and alpine slopes. Greenland to Alaska, southward to Labrador, Manitoba, Colorado, Utah, and New Mexico; Eurasia.

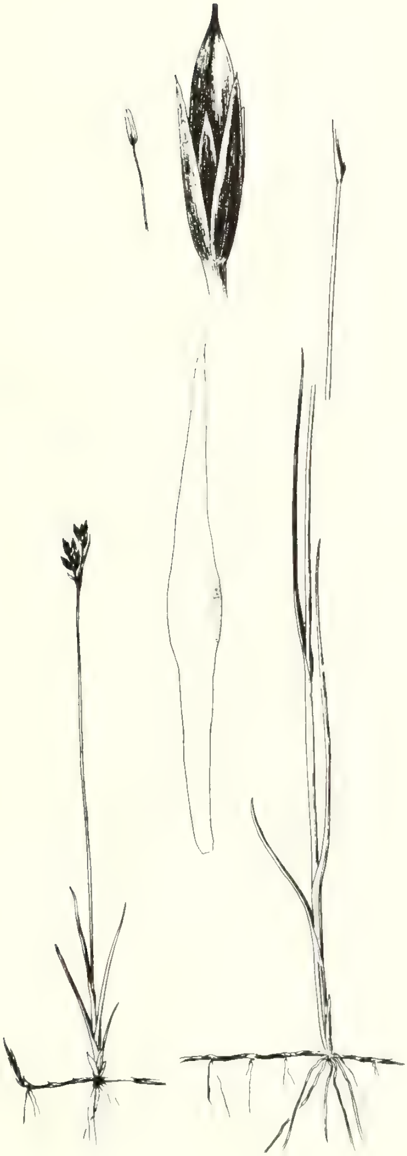


Plate 25. JUNCUS CASTANEUS

om Hitchcock et al., Vascular Plants of the Pacific Northwest)

6. § SEPTATI

*26. **Juncus brachycephalus** (Engelm.) Buch.

Juncus brachycephalus (Engelm.) Buch. in Engler, Bot. Jahr. 12: 268. 1890.

J. canadensis var. *brachycephalus* Engelm., Trans. Acad. Sci. St. Louis 2: 474. 1868.

Densely cespitose perennial; *stems* slender, 2.5-7 dm high, erect or sometimes reclining and rooting at the nodes, 2- 4-leaved; *leaves* all with well-developed blades, these terete and septate, usually 1-2 mm in diameter; *involucral bract* foliose; *inflorescence* a large (0.5-2.5 dm long), spreading, open or diffuse cyme, the heads numerous, small, 2-5-flowered; *perianth segments* greenish to light brown or reddish with hyaline margins, 1.75-2.5 mm long, much shorter than the capsule, the outer series shorter than the inner, lanceolate with obtuse to acute apex; *stamens* usually 3, but frequently 6, the number often varying in the same plant, the anthers much shorter than the filaments; *capsule* reddish-brown, prismatic, 2.4-3.8 mm long, abruptly narrowed into a short beak; *seeds* ellipsoid, 20- 30-ribbed, reticulate, caudate, 0.8-1.2 mm long, the body comprising about three-fifths of their length.

A species of shores (often calcareous), marshes and wet meadows in the eastern and midwestern states, known in our area only from El Paso County, Colo., where it may have been introduced: edge of small stream, Shaw Ranch, 4½ mi S. of Peyton, Aug. 22, 1946, *R. B. Livingston 1431* (CS); also reported from Black Forest, about 16 mi NNE. of Colorado Springs. Maine to northern Ontario and Minnesota, southward to Maryland, Ohio, and Indiana; sporadic and probably introduced, farther west.

*See addendum, page 100 .

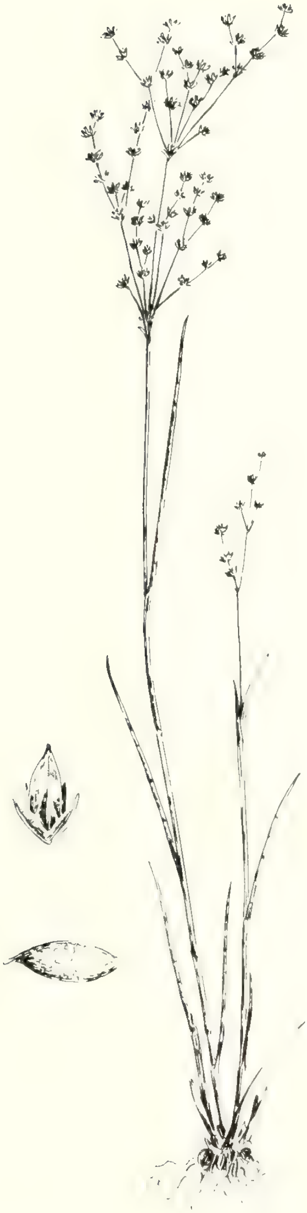


Plate 26. JUNCUS BRACHYCEPHALUS

27. **Juncus tweedyi** Rydb.

Juncus tweedyi Rydb., Mem. N.Y. Bot. Gard. 1: 90. 1900.
J. canadensis var. *coarctatus* Coult., Man. Bot. R. M. Reg. 358. 1885, not Engelm. 1866.
J. canadensis var. *kuntzei* Buch. in Engler, Bot. Jahr. 12: 272. 1890.
J. kuntzei Buch. ex Vierhapper., Engl. & Prantl, Nat. Pflanzenf., ed. 2, 15a: 218. 1930.

Cespitose perennial; *stems* 2-3.5 dm high, 2-3 mm in diameter, leafy to near the top; *lowest sheaths* bladeless, or with the blade reduced to a bristle, pale purplish-brown; *upper sheaths* with membranaceous, truncate auricles up to 3 mm long, the blades up to 12 cm long, terete or slightly flattened, septate; *involucral bract* usually shorter than the inflorescence; *inflorescence* of 4-10 heads (these 4- 8-flowered) in a contracted panicle, 1-5 cm long; *perianth segments* 3.5-4 mm long, subequal, narrowly lanceolate-acuminate, light brown to straw-colored; *stamens* 3, the anthers about 0.5 mm long, shorter than the filaments; *capsule* dark brown, oblong, acute, exceeding the perianth; *seeds* fusiform, 0.7-1 mm long, finely reticulate, very shortly apiculate-caudate at each end.

Very local in montane bogs, about springs and on river and lake margins. In Wyoming, where it is known only from Yellowstone National Park, it is apparently confined to the immediate vicinity of hot mineral springs and streams where it is often associated with *Panicum thermale.* South-central Montana, Idaho, Wyoming, and Utah.

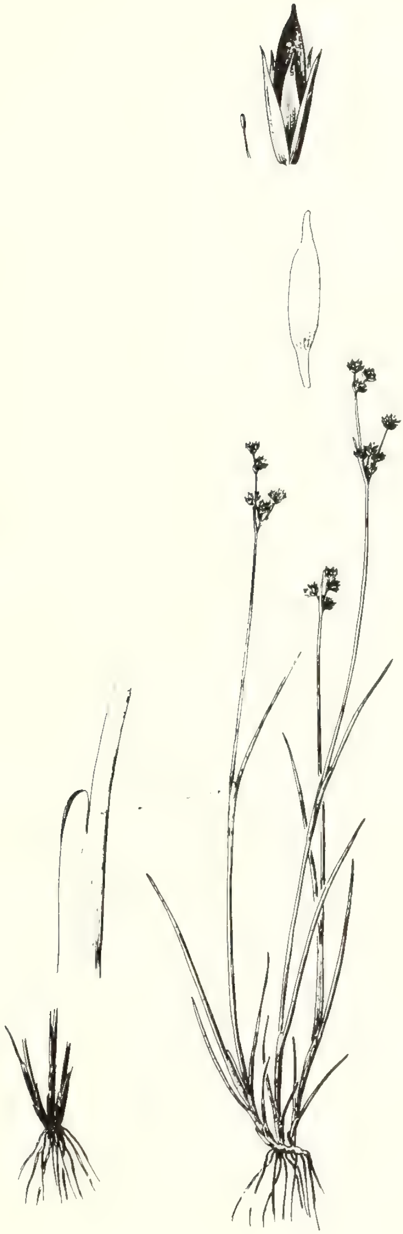


Plate 27. JUNCUS TWEEDYI

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

28. **Juncus acuminatus** Michx.

Juncus acuminatus Michx., Fl. Bor. Am. 1: 192. 1803.
J. bolanderi var. *riparius* Jeps., Fl. Calif., 1: 255. 1921.
J. acuminatus f. *sphaerocephalus* F. J. Herm., Leafl. West. Bot. 8: 13. 1956.

Cespitose perennial from short, inconspicuous rootstocks; *stems* erect, slender, 3-10 dm high; *leaves* 1-3 on a stem, the sheaths with rounded auricles 1.5-5 mm long, the blades semi-terete, conspicuously septate, the lower 1-3 dm long, 1-2 mm thick, the upper reduced; *involucral bract* shorter than the inflorescence; *inflorescence* paniculate, 5-15 cm long, loose, with generally 5-50 heads (sometimes reduced to 1) on spreading branches, the heads 5-10 mm wide, usually 5- 20-flowered; *perianth segments* light brown to greenish, 3-3.5 mm long, subequal, narrowly acuminate to subulate, equaling the capsule; *stamens* 3 (occasionally 6), about half as long as the perianth, the anthers about 0.7 mm long, shorter than the filaments; *style* almost none; *capsule* narrowly ovoid-prismatic, tapering to the mucronate apex, one-celled, light brown or straw-colored; *seeds* oblong-ellipsoid, 0.3-0.4 mm long, finely reticulate, minutely apiculate at each end.

In our area seen only from Arizona, where it is occasional on stream banks, lake margins and in wet meadows, and locally common in the Santa Catalina and Rincon Mountains (Pima County) at 3,000 to 6,500 ft., and from a single locality in Colorado (drying shore of Baseline Lake, 5,300 ft., Boulder County, *W. A. Weber 7970 and 8953*). Maine to British Columbia, southward to Georgia, Arizona, Oregon, and California.

J. acuminatus f. *sphaerocephalus* is a variant in which the heads are few, many-flowered and spherical rather than hemispherical.

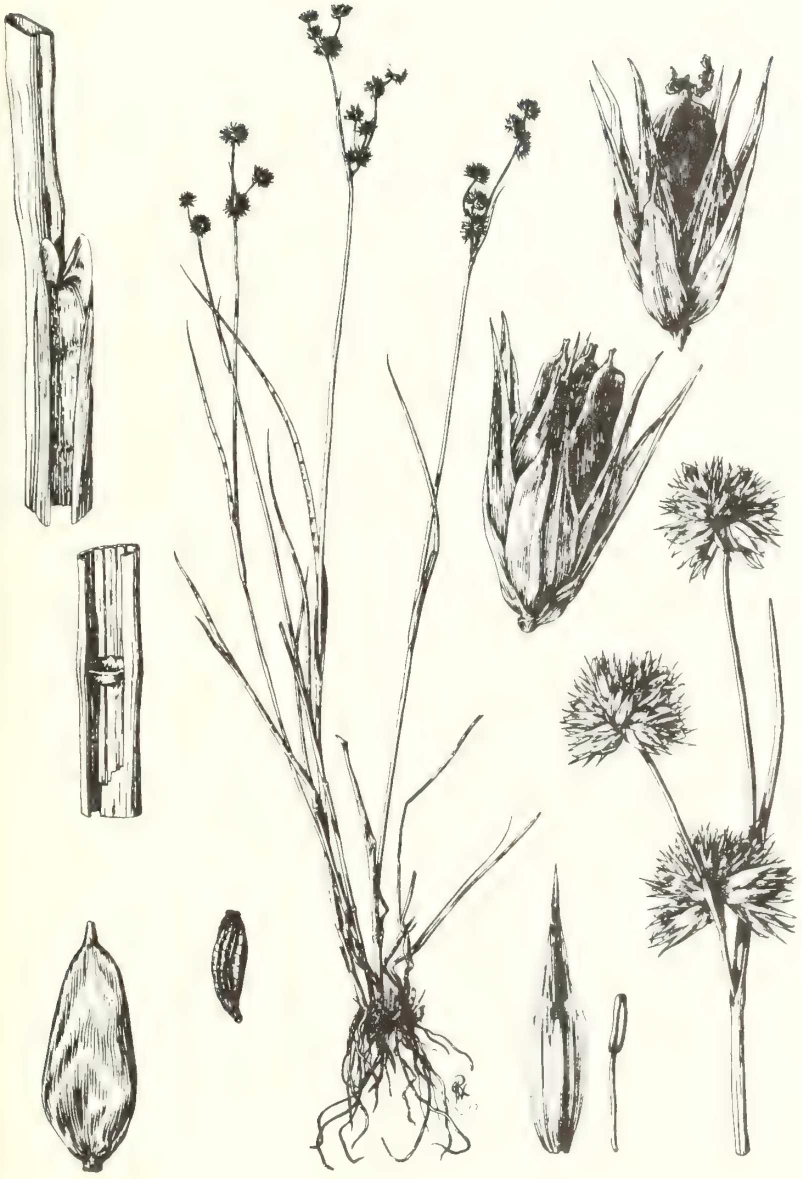


Plate 28. JUNCUS ACUMINATUS

(From Mason: Flora of the California Marshes)

29. Juncus nodosus L.

Juncus nodosus L., Sp. Pl., ed. 2, 466. 1762.

Perennial from creeping, thread-like, tuber-bearing rhizomes; *stems* slender, solitary, 1-4(5.5) dm high, with mostly 2-3 slender leaves; *leaves* erect, the sheaths projecting as small, rounded auricles about 1 mm long, the blades terete, septate, about 1 mm thick, the uppermost one and the involucral bract usually exceeding the inflorescence; *inflorescence* seldom exceeding 5 or 6 cm, bearing 3-15, many (6- 30)-flowered, spherical heads, 7-12 mm in diameter; *perianth segments* 3-4 mm long, greenish-brown to tawny, narrowly lanceolate and subulate-acuminate, but the tips not rigid, somewhat shorter than the capsule, the inner series equaling or very slightly exceeding the outer; *stamens* 6, about half as long as the perianth, the anthers 0.6-0.8 mm long, slightly shorter than the filaments; *capsule* prismatic-conic, one-celled, tapering from near the base into a long, non-dehiscent beak exceeding the perianth; *seeds* oblong to obovoid, 0.5 mm long, very finely reticulate, abruptly mucronate.

Occasional to frequent in moist to wet open habitats, especially pond margins and ditches, generally below 8,000 ft. Newfoundland to Alaska, southward to Virginia, New Mexico, and California.

Forage Value

Generally reported as good, averaging 60 percent to 80 percent grazed by horses and cattle.

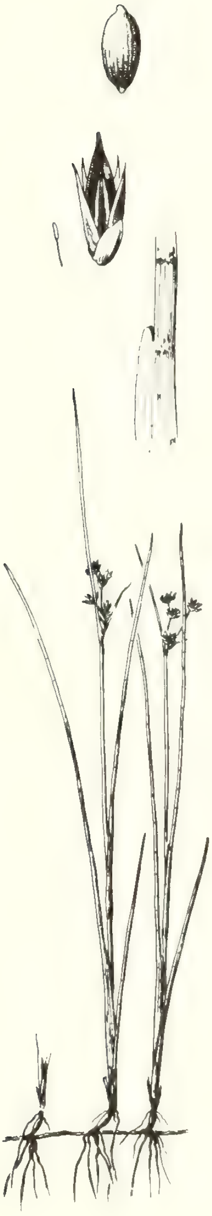


Plate 29. JUNCUS NODOSUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

30. **Juncus torreyi** Coville

Juncus torreyi Coville, Bull. Torrey Club 22: 303. 1895.
J. nodosus var. *megacephalus* (Wood) Torrey, Fl. N.Y. 2: 326. 1843.
J. megacephalus Wood, Class-book, ed. 2, 724. 1861, not Curtis 1837.

Perennial from slender, creeping rhizomes, tuberous at the nodes; *stems* stout, solitary, (3)4-10 dm high; *leaves* 1-4 on the stem, the sheaths projecting into rounded auricles 1-3.5 mm long, the blades stout, 2-5 mm thick, terete, septate, abruptly divergent from the stem, the uppermost and the involucral bract usually equaling or exceeding the inflorescence; *inflorescence* congested, consisting of 1-20 spherical heads, 30-80-flowered, 10-15 mm in diameter; *perianth segments* greenish-brown to tawny, (4)4.5-5 mm long, narrowly lanceolate and acuminate-subulate, the tips rigid, the outer generally somewhat longer than the inner; *stamens* 6, about half as long as the perianth, the anthers scarcely 1 mm long, shorter than the filaments; *capsule* narrowly prismatic-conic, tapering from near the base into a long, non-dehiscent beak usually equaling or slightly exceeding the perianth; *seeds* oblong-ellipsoid, about 0.4 mm long, finely reticulate, minutely apiculate at each end.

Frequent in moist to wet open habitats, mostly below 8,000 ft. Somewhat more southern in its distribution than *J. nodosus* and more frequent in our area. Massachusetts to Washington, southward to Alabama, Texas, Arizona, California and northern Mexico.

The relatively huge, leafy, grotesque heads often produced by a gall insect in many species of § Septati occur with greatest frequency in this species, in *J. nodosus* and *J. acuminatus,* but the parasite appears to be much more common farther east.

Forage Value

Although reported to be eaten by all classes of stock, *J. torreyi* is less palatable than *J. nodosus* so is generally rated as only fair.

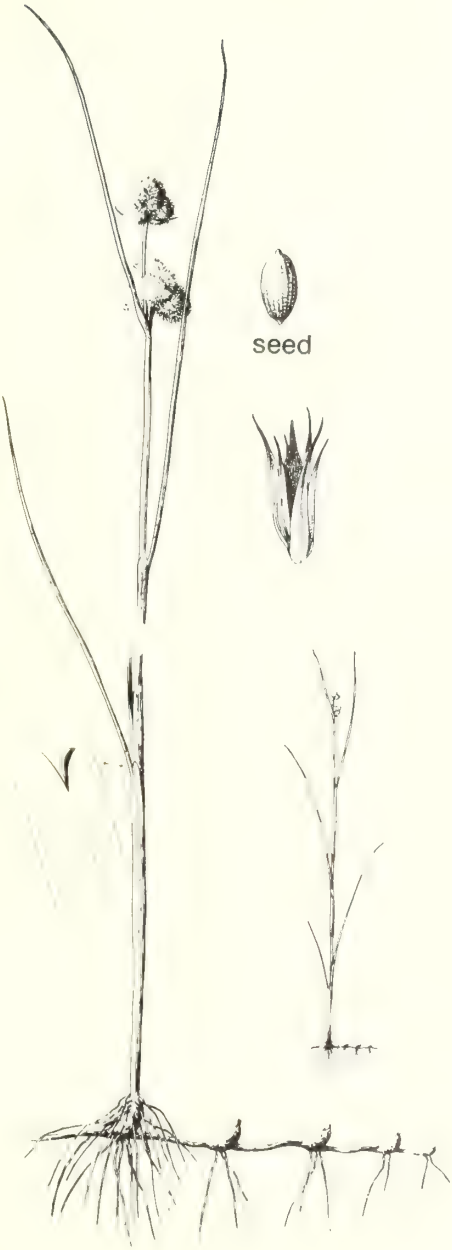


Plate 30. JUNCUS TORREYI

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

31. **Juncus articulatus** L.

Juncus articulatus L., Sp. Pl. 327. 1753.

J. articulatus var. *obtusatus* Engelm., Trans. Acad. Sci. St. Louis 2: 497. 1868.

Loosely cespitose perennial from branching rootstocks; *stems* erect or ascending, often rooting at the lower nodes, 1-6 dm high; *leaves* 1-3 on the stem, the loose sheaths with rounded auricles 1-1.5 mm long, the blades terete, septate, 5-10 cm long; *involucral bract* shorter than the inflorescence; *inflorescence* 2-15 cm high, with divaricate branches, the heads numerous, small, turbinate to hemispherical, 3- 12-flowered; *perianth segments* brown or greenish, 2-3 mm long, lanceolate, acute or acuminate, subequal; *stamens* 6, shorter than the perianth, the anthers shorter than the filaments; *capsule* dark brown, exceeding the perianth, three-angled, tapering to a conspicuous tip, one-celled; *seeds* oblong to obovoid, 0.5 mm long, very lightly striate longitudinally, minutely apiculate at each end.

Wet ground. Known sparingly from Arizona, Colorado, Utah, and Idaho. Newfoundland to British Columbia, southward to Maryland, West Virginia, northern Indiana, Minnesota, Utah, Arizona, and Idaho; Eurasia.

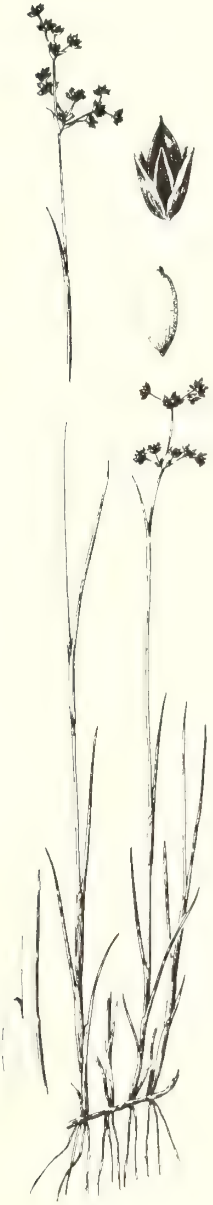


Plate 31. **JUNCUS ARTICULATUS**

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

32. **Juncus alpinus** Vill.

Juncus alpinus Vill., Hist. Pl. Dauphiné 2: 233. 1787.
J. richardsonianus Schultes in Roem. & Schult., Syst. 7: 201. 1829.

Cespitose perennial from short-creeping rhizomes; *stems* erect or slightly decumbent, sometimes rooting at the nodes, 1-4 dm high; *leaves* 1-3 on the stem, auriculate, the blades terete, septate; *involucral bract* usually shorter than the inflorescence; *inflorescence* 2-15 cm long, the branches rather strictly ascending, the heads usually 4-30, mostly 3- 10-flowered, the flowers sessile or equally short-pedicelled; *perianth segments* pale to deep purplish-brown, 2-2.5 mm long, the inner usually slightly shorter than the outer, obtuse, the outer oblong, acute or mucronate; *stamens* 6, one-half to two-thirds as long as the perianth, the anthers shorter than the filaments; *capsule* ovoid-oblong, incompletely three-celled, as long as or slightly exceeding the perianth, straw-colored or brown, obtuse or short-pointed at the apex; *seeds* fusiform, about 0.5 mm long, very lightly striate longitudinally, minutely apiculate at each end

Occasional in wet, often calcareous, montane to subalpine habitats in Colorado, becoming infrequent in Wyoming and Utah and frequent farther north. Newfoundland to Alaska, southward to Quebec, Minnesota, Colorado, Utah, and Washington; Eurasia. A polymorphic species, in the eastern and midwestern States represented by var. *rariflorus* Hartm. and var. *fuscescens* Fern., which seem not to extend to our area.

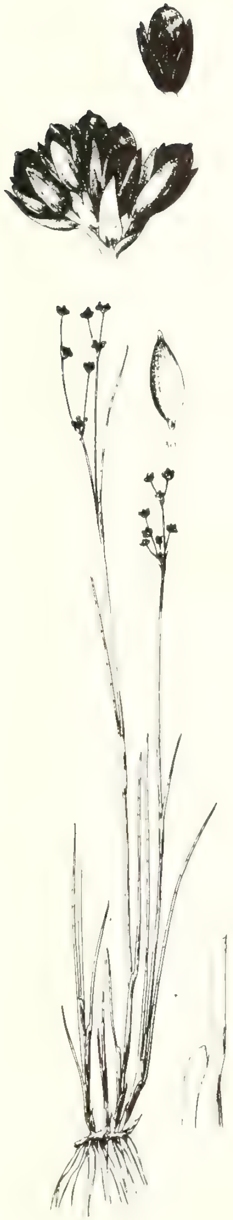


Plate 32. JUNCUS ALPINUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

33. **Juncus mertensianus** Bong.

Juncus mertensianus Bong., Mém. Acad. St. Pétersb. VI, 2: 167. 1833.

Cespitose perennial from short, matted rootstocks; *stems* slender and weak, somewhat flattened, 1-4 dm high; *leaves* 1-4 on a stem, laterally compressed, obscurely septate, 5-12 cm long, 0.5-1.5 mm wide, the sheaths projecting into rounded, opaque, membranaceous auricles 1-2 mm long; *involucral bract* from shorter to longer than the inflorescence; *heads* usually solitary, sometimes 2 or 3, subglobose or somewhat hemispherical, usually many-flowered, up to 2 cm wide; *perianth segments* dark brown, narrowly margined, 3-4 mm long, subequal, lanceolate, acuminate, subulate at the apex; *stamens* 6, nearly equaling the perianth, the anthers scarcely 1 mm long, shorter than the filaments; *capsule* oblong-obovoid, abruptly rounded-truncate and more or less retuse at the apex, almost equaling the perianth; *seeds* lanceolate-ovoid, scarcely 0.5 mm long, finely reticulate, minutely apiculate at each end.

Common in montane to alpine meadows and on stream banks and lake margins. Alaska to Alberta, southward to California and New Mexico; eastern Asia.

Forage Value

Fair for all stock. As an example of the varying palatability of rushes between one locality and another, often little separated, three reports on this species from the Gallatin National Forest, Montana, designate it, respectively, as "low, if any," "excellent," and "80 percent grazed." In the Madison National Forest, Montana, it is said to be "too wiry for good sheep feed," whereas a report from the Idaho National Forest, Idaho maintains that "sheep eat it readily," and three other forests report it as grazed mainly by sheep.

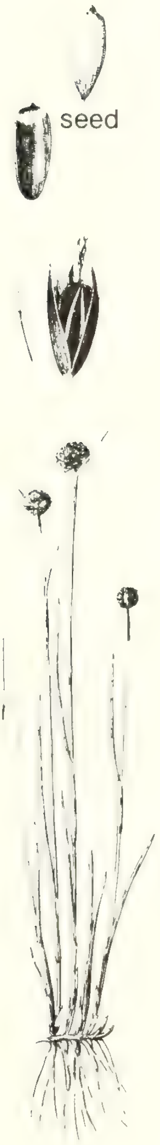


Plate 33. JUNCUS MERTENSIANUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

34. **Juncus nevadensis** Wats.

Juncus nevadensis Wats., Proc. Am. Acad. 14: 303. 1879.
J. phaeocephalus var. *gracilis* Engelm., Trans. Acad. Sci. St. Louis 2: 484. 1868.
J. mertensianus ssp. *gracilis* (Engelm.) F. J. Herm., Leafl. West. Bot. 10: 85. 1964.
J. suksdorfii Rydb., Bull. Torrey Club 26: 541. 1899.
J. mertensianus ssp. *gracilis* var. *suksdorfii* (Rydb.) F. J. Herm., Leafl. West. Bot. 10: 86. 1964.
J. columbianus Coville, Proc. Biol. Soc. Wash. 14: 87. 1901.
J. nevadensis var. *columbianus* (Coville) St. John, Fl. SE. Wash. 82. 1937.
J. mertensianus ssp. *gracilis* var. *columbianus* (Coville) F. J. Herm., Leafl. West. Bot. 10: 86. 1964.

Somewhat cespitose perennial from creeping rootstocks; *stems* 1-7 dm high, slender, somewhat compressed; *leaves* subterete, slightly compressed, completely but sometimes obscurely septate, the sheaths projecting into membranaceous auricles 1-3 mm long, the blades 5-20 cm long, 1-2 mm thick; *involucral bracts* much shorter than the inflorescence; *inflorescence* a loose panicle 1-12 cm long, of mostly 5-30, few-flowered, flattened-hemispherical to turbinate heads, 4-10 mm wide; *perianth segments* 3-5.5 mm long, lanceolate-acuminate, from light brown to dark purplish-brown, scarious margined, subequal or the outer segments slightly longer; *stamens* 6, the anthers linear, 1-2 mm long, usually much longer than the filaments; *capsule* dark brown, oblong, rather abruptly contracted into a short beak, about equaling the perianth; *seeds* obliquely obovoid, barely 0.4 mm long, lightly reticulate, minutely apiculate at each end.

Wet banks and meadows, especially along the margins of streams and lakes, from the lowlands to alpine. Rare to occasional in Colorado, western Wyoming, Utah, and Montana, becoming plentiful farther west. Southern British Columbia to California, eastward to western Montana, Wyoming, and Colorado.

Forage Value

Good to excellent for cattle and horses, especially as early feed and in hay; less palatable to sheep. One report specifies: "when dry not palatable to sheep but eaten closely by cattle." (See note under *J. tracyi* on importance in hay.)

34a. Juncus nevadensis var. badius (Suksd.) C. L. Hitchc.

Juncus nevadensis var. *badius* (Suksd.) C. L. Hitchc., in Hitchcock *et al.*, Vasc. Plants Pac. NW. 1: 201. 1969.
J. badius Suksd., Deuts. Bot. Monats. 19: 92. 1901.
J. mertensianus ssp. *gracilis* var. *badius* (Suksd.) F. J. Herm., Leafl. West. Bot. 10: 86. 1964.
J. truncatus Rydb., Bull. Torrey Club 31: 399. 1904.

Similar to var. *nevadensis* but with only 2-5 heads, the perianth about 3 mm long, and anthers only slightly longer than the filaments.

Chiefly montane and subalpine. Washington and Oregon, eastward to Montana, and southward to Wyoming, Colorado, northern Arizona, northern New Mexico and Chihuahua, Mexico. The commoner form eastward.

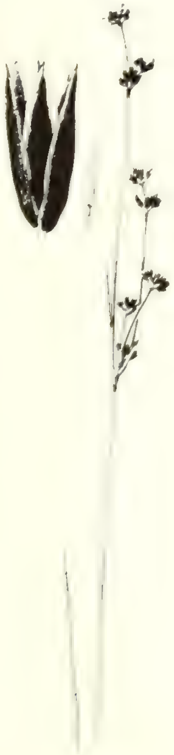


Plate 34.

JUNCUS NEVADENSIS

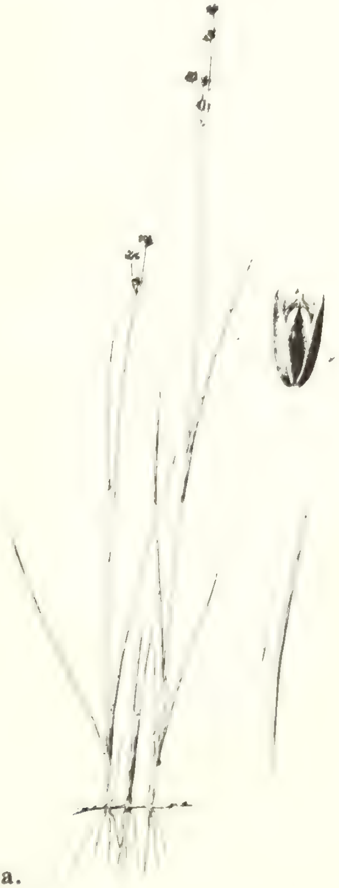


Plate 34a.

JUNCUS NEVADENSIS VAR. BADIUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

7. § ENSIFOLII

35. **Juncus ensifolius** Wikst.

Juncus ensifolius Wikst., Vet. Akad. Handl. Stockh. 2: 274. 1823.
J. xiphioides var. *triandrus* Engelm., Trans. Acad. Sci. St. Louis 2: 482. 1868.

Perennial from creeping rootstocks; *stems* 2-6 dm high, compressed, two-edged; *leaves* 1-3 on a culm, the blades flat, strongly compressed laterally, distinctly equitant, partially septate, 7-15 cm long, 3-6 mm wide, the sheath margins rarely prolonged into auricles; *involucral bract* ensiform, usually half the length of the inflorescence or more; *inflorescence* paniculate, of generally 2-5 purplish-brown heads; *perianth segments* lanceolate-acuminate, pale greenish-brown to deep brownish-purple, 3-4 mm long, subequal; *stamens* 3, about two-thirds the length of the perianth, the anthers 0.5-0.7 mm long, shorter than the filaments; *style* usually about 0.5 mm long; *capsule* oblong, abruptly contracted into the beak, usually slightly exceeding the perianth; *seeds* broadly fusiform, finely striate-reticulate, minutely apiculate at each end.

Wet meadows and marshy areas; montane. So far known from a single collection in Arizona (Square Lake, *P. A. South* in 1910) and four in Colorado (Routt and Pitkin Counties), but locally frequent in Wyoming and Utah, and very common in Idaho, western Montana, and westward. Alaska to California and northern Mexico, eastward to Alberta, Montana, and Colorado; also in Quebec (Nottaway River).

Forage Value

Variable as forage, from poor in some areas to excellent in others, especially for cattle and horses; more palatable when young and most valuable as hay.

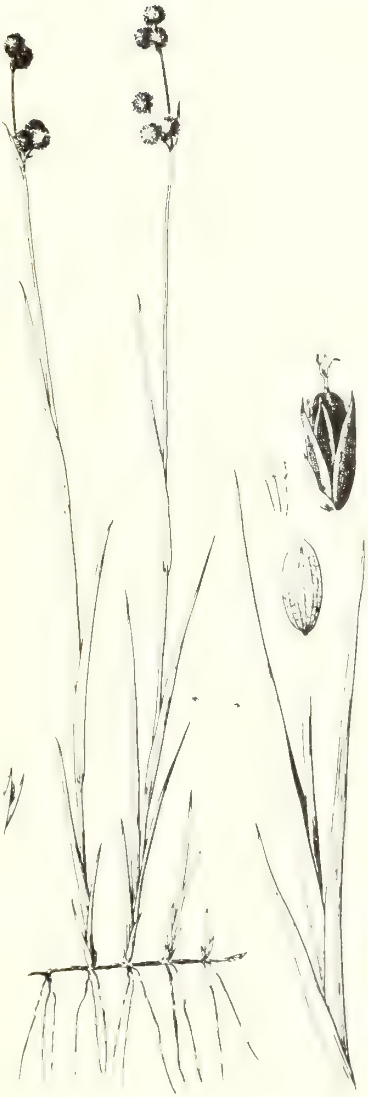


Plate 35. JUNCUS ENSIFOLIUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

36. **Juncus xiphioides** E. Mey.

Juncus xiphioides E. Mey., Syn. Junc. 50. 1822.
J. xiphioides var. *auratus* Engelm., Trans. Acad. Sci. St. Louis 2: 481. 1868.
J. xiphioides var. *littoralis* Engelm., Trans. Acad. Sci. St. Louis 2: 481. 1868.

Perennial from a thick, creeping rootstock; *stems* 5-9 dm high, stout, compressed; *leaves* equitant, flattened laterally, the sheaths without auricles, the blades 10-40 cm long, (3)7-12 mm wide; *involucral bract* less than half the length of the inflorescence; *inflorescence* a compound panicle of numerous 3- 20-flowered heads; *perianth segments* lanceolate-acuminate, very narrow (revealing the capsule), equal, 3-3.5 mm long, usually light brown, spreading; *stamens* 6, half as long as the perianth, the anthers somewhat shorter than the filaments; *capsule* oblong, acute, gradually contracted below the beak, slightly exceeding the perianth; *seeds* lanceolate-ovoid, reticulate.

Wet habitats in general. In our area known only from Arizona, where it is especially common in the Santa Rita Mountains at 3,500 ft and higher. Southern Oregon and California to Baja California and Arizona.

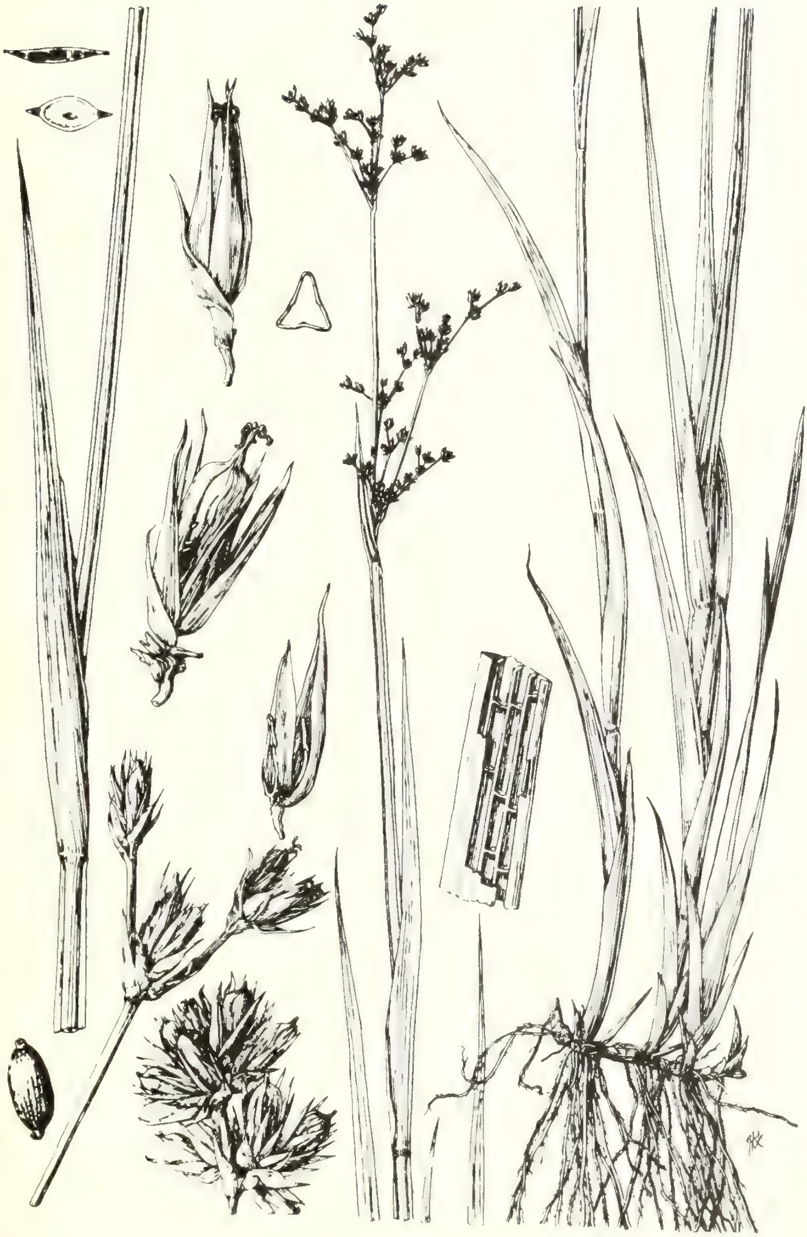


Plate 36. JUNCUS XIPHIOIDES
(From Mason: Flora of the California Marshes)

37. **Juncus tracyi** Rydb.

Juncus tracyi Rydb., Fl. Rocky Mts. 155 & 1061. 1917.
J. utahensis Martin, Rhodora 40: 69. 1938.
J. tracyi f. *utahensis* (Martin) F. J. Herm., J. Wash. Acad. Sci. 30: 218. 1940. (A many-headed, few-flowered phase.)

Perennial from stout rhizomes; *stems* 3-6 dm high, compressed; *leaves* 1-3 on a stem, the scarious sheath-margins prolonged into rounded auricles 1-2 mm long, the blades equitant, laterally compressed, incompletely septate, 5-20 cm long, 1.5-4 mm wide; *involucral bract* short, inconspicuous; *inflorescence* paniculate, of 3-9 heads, usually 10-15 mm wide, many-flowered; *perianth segments* 3-4 mm long, lanceolate-acuminate, subequal or the inner slightly shorter, purplish-brown, appressed; *stamens* 6, the anthers from slightly shorter to slightly longer than the filaments; *style* about 1 mm long; *capsule* oblong, mucronate at the rounded apex; *seeds* narrowly oblong, 0.8-1 mm long, short-caudate at each end.

Wet, springy slopes, swamps, low meadows, stream banks, and moist open aspen groves; montane to subalpine. Occasional in New Mexico, Arizona, and central Colorado, becoming frequent to very common in western Colorado, Wyoming, Utah and western Montana. Alberta, Idaho, and Montana, southward to eastern Nevada, Wyoming, New Mexico, and Arizona.

Forage Value

Good; from 20 percent to 80 percent grazed; relished by cattle and horses. In the Gallatin National Forest, Montana, it is reported to be grazed from May 1 to October 31. At least locally it supplies a large and important part of the hay crop. The writer has observed the hay harvest in extensive meadows in the Bear River Valley (alt. 8,000 ft), northwest of the Uinta Mountains, Utah, and found the crop to consist almost entirely of a mixture of this species (predominating) and *J. nevadensis.*

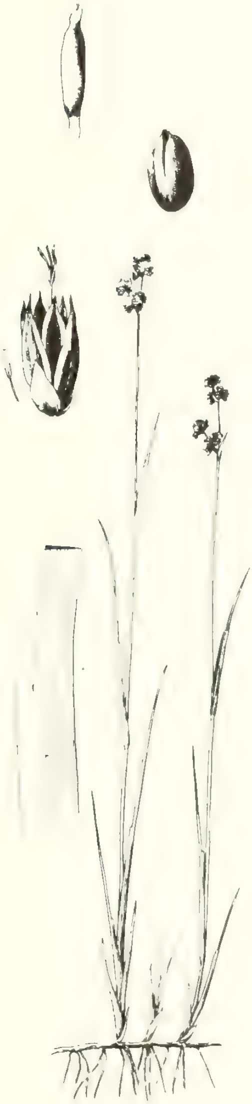


Plate 37. JUNCUS TRACYI

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

38. **Juncus saximontanus** A. Nels.

Juncus saximontanus A. Nels., Bull. Torrey Club 29: 401. 1902.
J. xiphioides var. *montanus* Engelm., Trans. Acad. Sci. St. Louis 2: 481. 1868.
J. parous Rydb., Bull. Torrey Club 31: 401. 1904.
J. ensifolius var. *montanus* (Engelm.) C. L. Hitchc. et al., Vasc. Plants Pac. NW. 1: 195. 1969.

Perennial from stout, creeping rootstocks; *stems* 4-6 dm high, compressed, two-edged; *leaf blades* flat, laterally compressed, equitant, partially septate, 10-25 cm long, 1.5-4 mm wide, the sheath margins usually prolonged into auricles; *involucral bract* usually less than half the length of the inflorescence; *inflorescence* paniculate, open, of generally 5;10(12) often pale-brownish, 15- 25-flowered heads, 7-10 mm in diameter; *perianth segments* lanceolate, often pale-brownish, 2.5-3 mm long, the outer slightly longer than the inner, appressed; *stamens* 6 (rarely 3), about two-thirds the length of the perianth, generally shorter than the filaments; *style* short, about 0.5 mm long; *capsule* oblong, obtuse below the mucronation, about equaling or slightly shorter than the perianth; *seeds* subfusiform, reticulate.

Frequent to fairly common in most of our area, from the piedmont to subalpine, in wet meadows, bogs, springy woods, and on stream banks and sandy lake shores. Alaska to California and northern Mexico, eastward to Alberta, Colorado, Arizona, and New Mexico.

Forage Value

Palatable to all stock and rated generally as good forage (60 percent grazed), especially early in the season. In the Cibola National Forest, New Mexico, it is reported to be cut for hay, as it probably is elsewhere within its range.

38a. **Juncus saximontanus** f. **brunnescens** (Rydb.) F. J. Herm.

Juncus saximontanus f. *brunnescens* (Rydb.) F. J. Herm., J. Wash. Acad. Sci. 30: 218. 1940.
J. brunnescens Rydb., Bull. Torrey Club 31: 400. 1904.

Differing from f. *saximontanus* in having the inflorescence composed of numerous (usually more than 10) heads, which are few (5-12)-flowered and average 5-6 mm in diameter. In typical *J. saximontanus* the few (seldom more than 10) heads are many (15-25)-flowered and average 7-10 mm in diameter. Forma *brunnescens* occurs essentially throughout the range of the typical form but in some areas is much more prevalent, and in others much less frequent, than f. *saximontanus:* in Arizona, for instance, it is by far the commonest rush in the State, whereas in Colorado and Wyoming it is rarity.

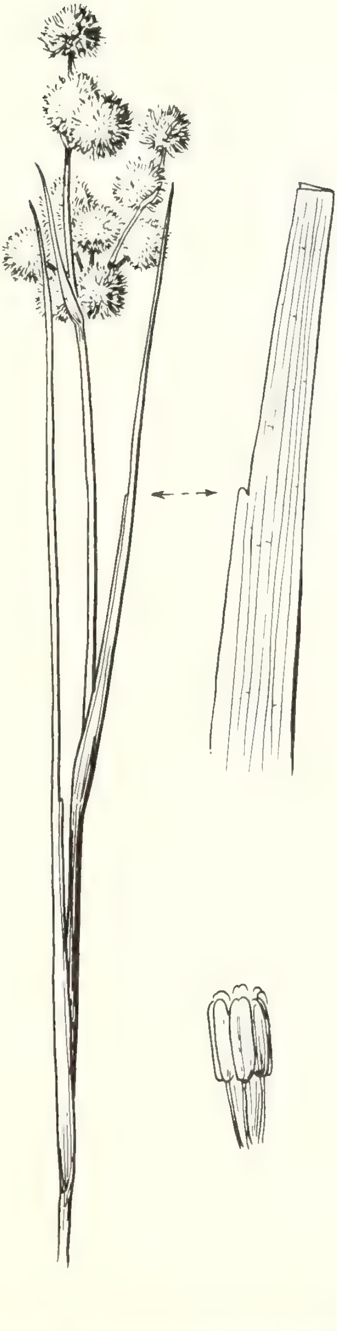


Plate 38. JUNCUS SAXIMONTANUS

(From Hitchcock et al., Vascular Plants of the Pacific Northwest)

ADDENDUM

After the completion of this manuscript word was received from Dr. Neil A. Harriman, Biology Dept., University of Wisconsin - Oshkosh, that a Colorado collection by Dr. C. W. Penland (*4935*) distributed as *Juncus brachycephalus* (Engelm.) Buch. and now in their herbarium, was actually *J. brevicaudatus* (Engelm.) Fern. I have examined the specimen and concur with Dr. Harriman's determination.

The data for this collection are as follows:

In shallow water; drainage of Black Squirrel Creek, few miles NE of Falcon, alt. 6800 ft., El Paso Co., Colo., Aug. 25, 1957.

Juncus brachycephalus was collected at the same site on the same date. The occurrence of both species so far from their geographic range as otherwise known (*J. brevicaudatus* being found from Labrador to northern Alberta, southward to Long Island and Pennsylvania, Michigan, northern Illinois, Minnesota, Manitoba and in the mountains of North Carolina) would suggest that they might be merely waifs at the Colorado station. However, Dr. William A. Weber informs me that the Black Squirrel Creek area is known for a congeries of relict mid-western species such as *Stipa spartea, Heuchera richardsonii, Pedicularis canadensis, Hypoxis hirsuta, Krigia biflora* and *Aster ptarmicoides,* and since these are certainly not introductions it may well be that the two unexpected *Junci* are also native there.

Juncus brevicaudatus would key out to *J. brachycephalus* in the key on page 74. It may be distinguished from it as follows:

Seeds with tails one-tenth to one-third as long as the body; sepals and petals ± blunt or rounded at the tip, soft and broadly scarious-margined; cyme open and diffuse, the capsule more or less spreading in the head .... *J. brachycephalus*

Seeds with tails half as long as the body; sepals and acute petals often subrigid, narrowly scarious-margined; cyme elongate, strict and generally narrow, the capsules erect-appressed in the head .... *J. brevicaudatus*

BIBLIOGRAPHY

1. Barrell, Joseph.
   1969. Flora of the Gunnison Basin. Natural Land Institute, Rockford, Ill. 494 p.
2. Booth, W. E.
   1950. Flora of Montana, Part 1. Research Foundation, Mont. State Coll., Bozeman. 232 p.
3. Buchenau, F.
   1906. Juncacae, in A. Engler, Das Pflanzenreich 4(36): 1-284.
4. Davis, R. J.
   1952. Flora of Idaho. W. C. Brown Co., Dubuque, Iowa. 828 p.
5. Dayton, W. A. et al.
   1937. Range plant handbook. U.S.D.A., Washington, D.C.
6. Engelmann, G.
   1866-68. A revision of the North American species of the genus *Juncus*, with a description of new or imperfectly known species. Trans. Acad. Sci. St. Louis 2: 424-498.
7. Fernald, M. L. and K. M. Wiegand.
   1910. The North American variations of *Juncus effusus.* Rhodora 12: 81-93.
8. Harrington, H. D.
   1954. Manual of the plants of Colorado. Sage Books, Denver. 666 p.
9. Hermann, F. J.
   1940. (With T. H. Kearney and R. H. Peebles) Arizona plants: New species, varieties, and combinations. J. Wash. Acad. Sci. 30: 217-219.
10. Hermann, F. J.
    1941. Juncaceae. In Ivar Tidestrom and T. Kittell, A flora of Arizona and New Mexico. Catholic Univ. of Am. Press, Washington, D.C. 897 p.
11. Hermann, F. J.
    1944. Juncaceae. In I. M. Johnston, Plants of northern Mexico—III. J. Arnold Arbor. 25: 56-59.
12. Hermann, F. J.
    1948. The *Juncus triformis* group in North America. Leafl. West. Bot. 5: 109-120.
13. Hermann, F. J.
    1956. The globose-headed form of *Juncus acuminatus.* Leafl. West. Bot. 8: 28-29.
14. Hermann, F. J.
    1960. Juncaceae. In T. H. Kearney and R. H. Peebles, Arizona flora. Univ. of Calif. Press, Berkeley. 1085 p.
15. Hermann, F. J.
    1964. The *Juncus mertensianus* complex in western North America. Leafl. West. Bot. 10: 81-87.
16. Hermann, F. J.
    1965. Juncaceae. In C. L. Porter, A flora of Wyoming. Univ. of Wyo. Agric. Exp. Stn. Bull. No. 434, p. 46-54.

17. Hitchcock, C. L., A. Cronquist, N. Ownbey, and J. W. Thompson.
1969. Vascular plants of the Pacific Northwest. Part 1. Univ. of Wash. Press, Seattle. 914 p.
18. Rydberg, P. A.
1922. Flora of the Rocky Mountains and adjacent plains. Ed. 2, N.Y. 1144 p.
19. Smith, E. C. and L. W. Durrell.
1944. Sedges and rushes of Colorado. Colo. Agric. Exp. Stn. Tech. Bull. 32. 63 p. Fort Collins, Colo.
20. Tidestrom, Ivar.
1925. Flora of Utah and Nevada. Contrib. U.S. Natl. Herb., 25: 1-665.
21. Vierhapper, F.
1930. Juncaceae in A. Engler and K. Prantl, Die Natürlichen Pflanzenfamilien 15a: 192-224.
22. Weber, W. A.
1961. Handbook of the plants of the Colorado Front Range. rev. ed. 232 p. Univ. of Colo. Press, Boulder.
23. Wiegand, K. M.
1900. *Juncus tenuis* Willd. and some of its North American allies. Bull. Torrey Club 27: 511-527.
24. Wooton, E. O. and P. C. Standley,
1915. Flora of New Mexico. Contrib. U.S. Natl. Herb. 19. 794 p.

GLOSSARY

Acuminate. Tapering gradually to a point.

Acute. Terminating in a sharp point.

Anther. The pollen-bearing part of a stamen.

Anthesis. The period during which a flower is fully expanded and functional.

Apiculate. Abruptly terminated in a small point.

Appressed. Lying close to and flat against.

Areolate. Marked out into small spaces; reticulate.

Aristate. Awned; tipped with a bristle.

Attenuate. Slenderly tapering or prolonged; more gradual than acuminate.

Auricle. A small, projecting lobe or appendage.

Auriculate. Furnished with auricles.

Blade. The expanded part of a leaf or petal.

Bract. A more or less modified leaf subtending a flower or belonging to an inflorescence.

Bracteate. Having bracts.

Bracteole. A tertiary bract, at the base of the perianth.

Bractlet. A secondary bract, at the base of a pedicel instead of at the base of an inflorescence.

Calcareous. Limy, or rich in calcium carbonate.

Capitate. Shaped like a head; collected into a head or dense cluster.

Capsule. A dry, dehiscent fruit, composed of more than one cell.

Cartilaginous. Firm and tough but flexible, like cartilage or the core of a pear.

Caudate. Having a slender, tail-like appendage.

Cauline. Belonging to the stem.

-celled. The number of locules in an ovary.

Cespitose. Growing in tufts.

Conduplicate. Folded together lengthwise.

Culm. The type of hollow or pithy slender stem found in grasses, sedges and rushes.

Cyme. A type of inflorescence in which the terminal flower blooms first, commonly also with the terminal flower of each branch blooming before the others on that branch.

Dehiscent. Opening at maturity, releasing or exposing the contents.

Depauperate. Impoverished, starved, stunted.

Divergent. Inclining away from each other.

Dorsiventral. Flattened, with the two flattened sides unlike; having a back side and a belly side.

Echinate. Provided with prickles.

Ellipsoid. Solid but with an elliptical outline.

Elliptic (*elliptical*). With the form of an ellipse.

Ensiform. Sword shaped, as the leaves of *Iris.*

Equitant. Astride, as if riding; used of conduplicate leaves which enfold each other in two ranks, as in *Iris.*

Eructate. Abruptly exserted.

Exserted. Projecting beyond - as stamens from a corolla.

Fastigiate. Crowded close together, more or less parallel and usually erect.

Filament. The stalk of the stamen, i.e., the part which supports the anther.

Filiform. Threadlike; long, slender and terete.

Floriferous. Flower-bearing.

Foliaceous. Leaflike.

Foliose. Bearing numerous or crowded leaves.

Fuscous. Grayish brown.

Fusiform. Spindle shaped; swollen in the middle and narrowing gradually toward each end.

Gladiate. Sword shaped, either straight or somewhat curved.

Glaucous. With a bluish or whitish, waxy covering.

Globose. Spherical; rounded.

Glomerules. Compact clusters.

Head. An inflorescence of sessile or subsessile flowers crowded closely together at the tip of a peduncle.

Hyaline. Thin and colorless or translucent, sometimes transparent.

Indurated. Hardened.

Inflorescence. The flowering part of a plant, especially the arrangement of the flowers on the axis.

Involucral bract. A bract beneath the inflorescence.

Involute. With the edges rolled inward, i.e., toward the upper side.

Lanceolate. Narrow and tapering to the apex, broadest near the base.

Ligule. A thin, collar-shaped appendage on the inside of the leaf-blade at the junction with the sheath.

Linear. Long and narrow, with parallel margins.

Lineolate. Marked with fine or obscure lines.

Membranaceous. Thin, soft and pliable, like a membrane.

Mucronate. With a short, sharp, abrupt and slender point.

Mucronulate. Diminutive of mucronate.

Node. A place on a stem where a leaf is, or has been, attached, often thickened or enlarged.

Obtuse. Blunt or rounded at the end.

Ob-. Latin prefix signifying the reverse or contrariwise.

Obovoid. Inversely ovoid.

Ovate. Flat and having the outline of an egg, broadest toward the base.

Ovoid. A three-dimensional figure, ovate in outline.

Panicle. A loose, irregularly compound inflorescence, with pedicellate flowers, such as a branched raceme.

Papillate, papillose. Covered with papillae, i.e., with short, rounded, blunt projections.

Parietal. Borne on the walls or on the intruded partial partition of a compound, unilocular ovary.

Pedicel. The stalk of a single flower in an inflorescence.

Pedicellate. Borne on a pedicel.

Peduncle. The stalk of an inflorescence or of a solitary flower.

Perianth. All of the sepals and petals (or tepals) of a flower, collectively.

Perianth segment. One of the parts of a divided perianth.

Placenta. The tissue of the ovary to which the ovules or seeds are attached.

Polymorphic. Occurring in several or many different forms.

Pungent. Terminating in a rigid, sharp point.

Reticulate. In the form of a network; net veined.

Retuse. With a shallow notch at a rounded apex.

Rhizome (or rootstock). A prostrate, more or less elongate stem, partly or completely beneath the surface of the ground and usually rooting at the nodes.

Rufescent. Reddish brown.

Scabrous. Rough to the touch.

Scape. A naked flowering stem rising from the ground.

Scapose. With the flowers on a scape.

Scarious. Thin, dry and chaffy in texture, not green.

Septa (sing., *septum*). Partitions.

Septate. Divided by partitions.

Sessile. Not stalked; attached directly by the base.

Setaceous. Bristle shaped.

Sheath. The tubular basal part of a leaf that encloses the stem.

Spathiform. Resembling, or in the form of, a large bract enclosing an inflorescence.

Spinescent. Ending in a spine, or bearing a spine.

Stamen. The male organ of a flower, consisting of an anther and usually a filament.

Stoloniferous. Bearing stolons.

Stolon. A trailing shoot above ground, often rooting at the nodes.

Stramineous. Straw colored.

Striate. Marked with fine longitudinal lines or streaks.

Style. The usually slender stalk which typically connects the stigma to the ovary.

Sub-. Latin prefix meaning almost or not quite.

Subulate. Awl shaped.

Taxon (pl. *taxa*). Any taxonomic entity, of whatever rank (such as a species, variety, form, etc.).

Terete. Circular in cross section; cylindrical.

Trigonous. A three-dimensional figure, triangular in outline.

Triquetrous. With three sharp or projecting angles.

Truncate. Cut squarely across at the apex or base.

Turbinate. Top shaped; inversely conical.

Umbonate. Bearing a rounded elevation or protuberance at the end or on the side of a solid organ.

Valve. One of the portions of the ovary wall into which a capsule splits at maturity.

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Accepted scientific names are in boldface italics; synonyms in plain italics. Common and section names are in Roman type.

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Agriculture CSU, Ft Collins

Hermann, Frederick J.
1975. Manual of the rushes (*Juncus* spp.) of the Rocky Mountains and Colorado Basin. USDA For. Serv. Gen. Tech. Rep. RM-18, 107 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521

A taxonomic treatment of the 51 taxa of the critical genus *Juncus* known from the Rocky Mountains and Colorado Basin. Detailed descriptions, synonymy, key for identification, illustrations, habitats, geographic distribution and data on forage value are included.

Keywords: Plant taxonomy, *Juncus,* Rocky Mountains, Colorado Basin, phytogeography, forage plants, Juncaceae.

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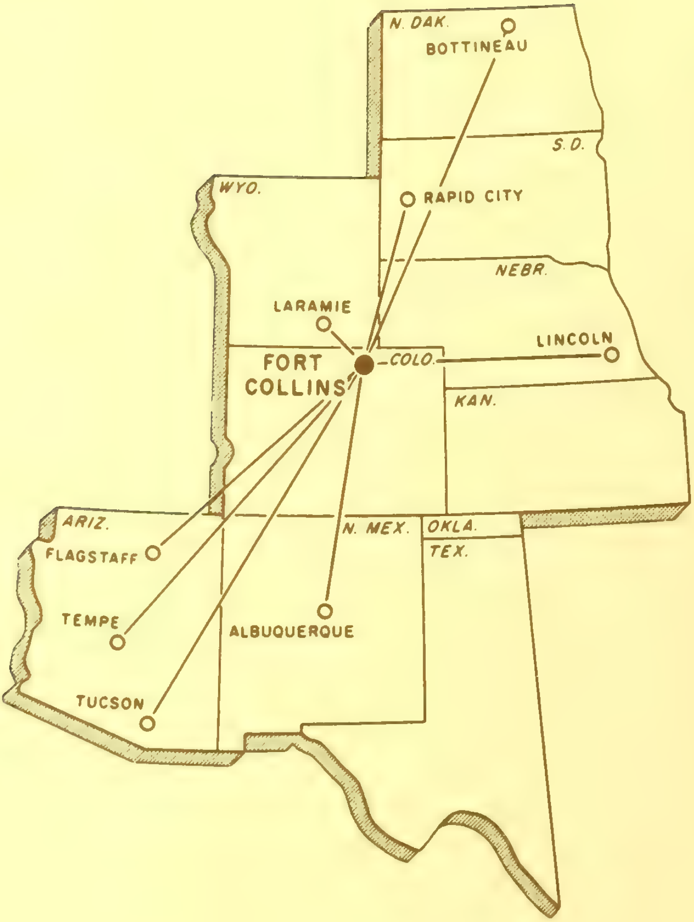
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he National Fire Weather ata Library:

hat It Is and How to Use It

William Furman and Glen E. Brink

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USDA Forest Service
General Technical Report RM-19

December 1975

Rocky Mountain Forest and
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U.S. Department of Agriculture
Fort Collins, Colorado 80521

Abstract

Furman, R. William, and Glen E. Brink.
1975. The national fire weather data library: What it is and how to use it. USDA For. Serv. Gen. Tech. Rep. RM-19, 8 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521.

The National Fire Weather Data Library is a collection of daily weather observations from fire weather stations across the Nation. Current data are accumulated on collection tapes, then merged onto library tapes annually. Example run streams are given for using the library on the UNIVAC 1108 computer at the Fort Collins Computer Center.

Keyword: Fire weather

USDA Forest Service
General Technical Report RM-19

December 1975

The National Fire Weather Data Library: What It Is and How to Use It

R. William Furman and Glen E. Brink[1]

What Is It?

The National Fire Weather Data Library is a collection of computerized historical weather data. The Library was conceived and assembled by the Forest and Mountain Meteorology Staff at the Rocky Mountain Forest and Range Experiment Station. A user-oriented version of the Library is maintained on the USDA UNIVAC 1108 at the Fort Collins, Colorado Computer Center (FCCC), by the National Fire Danger Rating Staff, Northern Forest Fire Laboratory, Missoula, Montana. The Library consists of daily weather observations, usually taken during the fire season, at sites maintained across the entire Nation by fire management agencies for use in their fire suppression planning.

The main source of current data is the fire danger rating program AFFIRMS (Administrative and Forest Fire Information Retrieval and Management System), (Furman and Helfman 1973, Helfman et al. 1975). For some fire weather stations, the length of record exceeds 15 years. The data are from active and inactive fire danger stations.

This pool of weather data is a valuable source of information on the climatology and meteorology of our forested and mountainous regions. It is available to all agencies who have access to the computer at the FCCC. For agencies that do not have access to FCCC, requests for data can be made directly to the authors.

What Is It For?

Data were initially collected by fire managers for input into fire management decisionmaking, because the National Weather Service observing stations were not located where they could monitor weather conditions meaningful to fire danger problems in forested areas. Federal agencies concerned with resource fire protection established their own network of weather observation stations in locations where the fire danger could be more accurately monitored. This fire danger network has grown to more than 800 stations monitoring weather once daily. The observations are taken during the early afternoon when fire danger is usually the worst. In addition to planning for fire suppression activities, the data have become useful for other planning efforts such as slash disposal, prescribed fire, and environmental impact evaluation.

There is also an important need for a good data base in support of forest meteorology research. The fire danger observations are a source of weather and climate information not available elsewhere. The importance of a forest and mountain climate data base is destined to increase as the management of our natural resources comes under closer public scrutiny.

It is therefore important to have a system designed to facilitate the cataloging and retrieval of the vast quantities of weather data being gathered from all parts of the Nation. The Fire Weather Data Library is such a system.

How Does It Work?

The Fire Weather Data Library was designed to facilitate the cataloging and retrieval of the large quantities of data for research being conducted at the Rocky Mountain Forest and Range Experiment Station in forest and mountain meteorology. The primary source of current data is a tape prepared by AFFIRMS from information gathered via a timeshare computer system from participating agencies across the Nation. Each participating unit relays weather information via computer terminal to AFFIRMS where fire danger indexes are computed, and the weather information is stored for future retrieval. Historic data for years past, obtained from a number of sources in many different formats, are included in the Library.

The Library system has two main parts, the 'collection' tape and the 'library' tapes. The collection tape is updated weekly. As data are received at the Rocky Mountain Station from AFFIRMS, or as new historic data are received from other sources, they are sorted and merged onto the collection tape. These data are available for anyone having a need of current-year data. In January of each year the collection tape is merged onto the library tapes and a new collection tape is started. The library tape is the repository for all but the current year's data and

---

[1] *Authors are Meteorologist and Computer Programer, respectively, Rocky Mountain Forest and Range Experiment Station, with central headquarters maintained at Fort Collins, in cooperation with Colorado State University.*

Table 1. FIRE WEATHER DATA - CARD EDITING AS OF NOVEMBER 1, 1975

Item	Column	Minimum Value	Maximum Value	Error	Action taken with notification[1]
Station Number	1-6	1	509999	Outside range of permissible values	Card rejected
Year	7-8	0	99	Blank field	Card rejected
Month	9-10	1	12	Outside range of permissible values	Card rejected
Day	11-12	1	31	Outside range of permissible values	Card rejected
State of weather	13	0	9		None
Dry-bulb temp.	14-16	-99	136	Outside range of permissible values or blank field	Card rejected
Humid. variable	17-19			Outside range of permissible values or blank field	Card rejected
Wet-bulb (col. 61=1) Rel. humid. (col. 61=2) Dewpoint (col. 61=3)		-99 0 -99	Dry-bulb 100 Dry-bulb		
1-Hr. TLFM (Time Lag Fuel Moisture)	20-22				Unconditionally converted to blanks
Herb. veg. condition	23-24	0	99[2]	Outside range of permissible values	Converted to blanks
Man-caused risk	25-27	0	100	Outside range of permissible values	Converted to blanks
Wind direction	28	0	8	Outside range of permissible values	Converted to a blank
Wind speed	29-31	0	99	Outside range of permissible values	Converted to blanks
Woody veg. condition	32	5	9	Value other than 5, 7, or 9	Converted to blanks
10-Hr. TLFM	33-35	0	99	Value of -25 Value of -1 through -24 Outside range of permissible values	Converted to 025 (without notification) Converted to 001 through 024 Converted to blanks
100-Hr. TLFM	36-38				Unconditionally converted to blanks
24-Hr. max. temp.	39-41	Dry-bulb[3]	136	Max.=min.=100 Outside range of permissible values	Both fields converted to blanks Converted to blanks
24-Hr. min. temp.	42-44	-99	Dry-bulb[3]	Outside range of permissible values	Converted to blanks
24-Hr. max. rel. humid.	45-47	1	100	Max.=min.=100 Outside range of permissible values	Both fields converted to blanks Converted to blanks
24-Hr. min. rel. humid.	48-50	1	100	Outside range of permissible values Min.> max.	Converted to blanks Both fields converted to blanks
Precip. kind	51	0	9		None
Precip. duration	52-53	0	24	Negative value >24	Converted to its absolute value Converted to a blank
Precip. amount	54-57	0	999 ^	Col. 54=T Outside range of permissible values	Col. 55-57 converted to zeros Converted to blanks
Lightning activity level	58-60	1	5	Outside range of permissible values	Converted to blanks
Humid. variable indicator	61	1	3	Value other than 1, 2, or 3	Card rejected

[1] Notification consists of printing the offending field along with a message stating the action taken.

[2] Some historic data contained codes -1, -2 and -3, which were retained during the edit, but all new entries must be within the specified limits.

[3] Due to slight differences in instruments, a variance of 5° from dry-bulb temperature for the limits on daily extreme temperatures is allowed.

NOTES.--Valid characters are the digits 0 through 9; - is allowed in certain fields; T is allowed in column 54. Invalid characters cause the field to be converted to blanks, with notification. Leading and embedded blanks are converted to zeros without notification. Unless otherwise specified, fields that are entirely blank remain unchanged.

newly acquired historical data. The data in the library are stored on several computer tapes in a sorted order by station number, then by date. Hence fire weather data are available to users from both the library and collection tapes, which contain all data of record and are current to within a month.

Forecasts (saved by request of the user) received from AFFIRMS are stored on a separate 'forecast' tape. Forecasts are collected for an entire year and then are sent to USFS regional data processing centers. No library of forecast data is maintained. At any time during the year, however, data on the forecast tape are available to users in exactly the same manner as data on the collection tape.

Retrieval of information stored on the library, collection, and forecast tapes is facilitated by a collection of routines called GETDATA available to all users on demand. These routines perform the functions of finding the information requested by the user, and transferring it to some storage device (tape, disk, or cards). These routines can retrieve large or small blocks of information such as all records for a given State, or a year's data for an individual station.

Data arriving at the Rocky Mountain Station are first screened and edited according to the criteria listed in table 1. In instances when a data record is rejected an effort is made to salvage it. Usual procedure is to send a list of the rejected data to the originating agency and ask for corrections from the source documents. The corrected data records may then be returned to the Rocky Mountain Station and checked again. Checked data are sorted by station number and date, and merged onto the appropriate collection or forecast tape. At this time, data are checked for duplicate station-date entries. If duplicates occur in the incoming data only, the last of the duplicate records encountered will be saved and merged. If a duplicate station-date is found on the collection tape, the new record will replace the existing record. In both situations, messages are printed to inform the library manager of the action taken.

At the end of the calendar year, the collection tape is merged onto the library tapes. As with the collection tape, new or incoming records will replace existing records where duplications in station-dates are encountered. Erroneous data can be corrected in this manner. At this time, the lag in the recording of lightning activity level (Deeming et al. 1972) is removed, so that the lightning activity level applies to the date of the record, not the previous day. Otherwise the data are not altered.

As the volume of stored data increases, more tapes must be used and the redistribution of data over the old and new library tapes must be recognized. Hence, a short cross reference of station-years and file names is available, and should be accessed at least once a year (around January 31) to verify the location of a particular State or station (an example follows in a later section).

How Can It Be Used?

A major effort has been made to construct a *useful* data retrieval system. Access to the Fire Weather Data Library is therefore provided by a series of routines entitled GETDATA. In the discussion that follows, we will be concerned with retrieval of data from the library stored on the U.S. Department of Agriculture UNIVAC 1108 computer at the FCCC. This library is actually a duplicate of the one maintained for research purposes on the Colorado State University CDC 6400 computer, thus assuring a modest level of protection against data loss.

The program file FIREDATALIB*PROGRAMS at FCCC contains the software to obtain the following kinds of information from the data library;

I. A listing of file names and station-year limits.
II. An inventory of the data on any given data tape.
III. A file of selected data for analyses.
IV. A list of card images.

Sample run streams with explanations follow.

I. Obtaining File Names

The following run will print a short table, including the station-year limits for each reel. Those limits are of the form SSSSSSYY (SSSSSS = station number, YY - year) and may represent an allowable range of data as opposed to an actual station-year appearing in the library.

1. Obtain exclusive use of the program file.
2. Execute the absolute element which will produce the table.
3. Terminate the run.

```
1. @ASG,AX FIREDATALIB*PROGRAMS.
2. @XQT FIREDATALIB*PROGRAMS.LISTFILES
3. @FIN
```

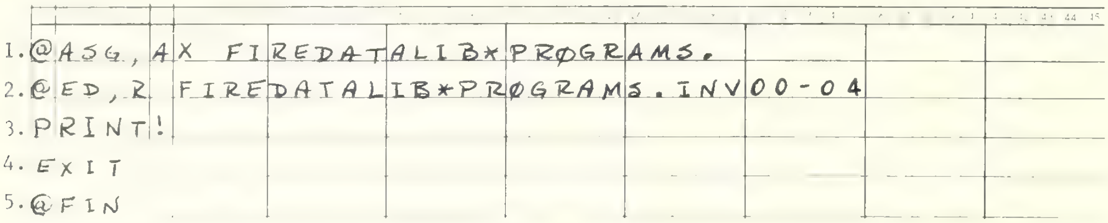
```
                            STATION-YEAR LIMITS    DATE OF
FILE                        FROM       THROUGH     LAST UPDATE

FIREDATALIB*00-04           00000000   04079999      062475
FIREDATALIB*04A             04080000   04510599      062475
FIREDATALIB*04B             04510600   04999999      070175
FIREDATALIB*05-09           05000000   09999999      061975
FIREDATALIB*10-20           10000000   20999999      062175
FIREDATALIB*21-26           21000000   26999999      062075
FIREDATALIB*27-41           27000000   41999999      062575
FIREDATALIB*42-47           42000000   47999999      070375
FIREDATALIB*48-50           48000000   50999999      070375
FIREDATALIB*NEWYR           00000000   99999999      101075
FIREDATALIB*FRCST           00000000   99999999      101075

NOTE - THE TIME LAG IN THE RECORDING OF THE LIGHTNING ACTIVITY LEVEL
 HAS BEEN REMOVED FROM THE DATA IN THE REGULAR LIBRARY, BUT IS STILL
 PRESENT IN THE NEW DATA BEING COLLECTED (NEWDAT).  IT WILL BE
 REMOVED WHEN THAT DATA IS MERGED INTO THE REGULAR LIBRARY.
```

II. Obtaining a New Inventory

The cross-reference table produced in part I supplies the date of the last update to each tape. When desired, a new inventory may be printed by the following:

Note: The user who is familiar with the UNIVAC EXEC 8 features may wish to use list processors other than the EDITOR; or it may be desirable to use commands within the EDITOR other than PRINT! to obtain only certain portions of the inventory. The PRINT command will produce an average of 6 pages of inventory information.

1. Obtain exclusive use of the program file.
2. Enter the editor in READ mode. The element name must be supplied and it begins with INV followed by the file name.
3. Editor lists the entire element and displays the following:
   a. station number
   b. total number of records (a record represents one day's data)
   c. years represented in the records
   d. number of records for each year
4. Exit from editor.
5. Terminate the run.



```
1.@ASG,AX FIREDATALIB*PRØGRAMS.
2.@ED,R FIREDATALIB*PRØGRAMS.INV00-04
3.PRINT!
4.EXIT
5.@FIN
```

```
INVENTORY OF FIRE WEATHER DATA TAPE 00-04  AS OF  06/24/75
    PAGE   1  STATION-YEAR LIMITS 00000000 THROUGH 04079999

STATION    TOT REC   YR (N REC) . . .

000111        547    70 (201), 71 (176), 72 (170),
000486       1489    64 (152), 65 (122), 66 (142), 67 (184), 68 (173),
                     69 (184), 70 (174), 71 (181), 73 (177),
000582       1579    64 (184), 66 (173), 67 (184), 68 (184), 69 (183),
                     70 (184), 71 (183), 72 (166), 73 (138),
000583       1723    64 (170), 65 (184), 66 (184), 67 (184), 68 (184),
                     69 (184), 70 (174), 71 (179), 72 (111), 73 (169),
000961        243    73 ( 92), 74 (151),
001115        629    70 (188), 71 (183), 72 (182), 73 ( 76),
002201         30    66 ( 30),
003040         10    66 ( 10),
003201        198    73 ( 75), 74 (123),
009002        243    73 ( 92), 74 (151),
010701       2191    65 (365), 66 (365), 67 (365), 68 (366), 69 (365),
                     70 (365),
012701       2191    65 (365), 66 (365), 67 (365), 68 (366), 69 (365),
                     70 (365),
015902       1733    65 (279), 66 (364), 67 (364), 68 (366), 69 (360),
020101        914    65 (107), 66 (107), 67 (151), 69 (106), 70 (138),
                     71 (153); 72 (152),
```

⋮

III. Obtaining Data for Analysis

The data may be obtained as card images[2] or in the station-year blocking format. The card image format is simplest to use since the resulting file may be read by the normal formatted READ or it may be "added" to the input stream by the use of the @ADD,E command. One possible use of the second format, the station-year blocks, is to create a library tape for a particular area that crosses State boundaries. An example would be the Yellowstone area: Data from Wyoming, Idaho, and Montana may well be on three separate reels; by creating a tape containing only selected data, the user could still have the benefits of rapid access to any part of the data without accessing two or three tapes.

A. Data Card Format

col	contents
3-10	First Station-year
13-20	Last Station-year
25	Blank for card images; 1 for station-year blocks.

Sample data:

1.	0 4 0	3	0 7 7 4			
2.	0 4 5	1	05 6 1	0 4 5	1 0 5 7 0	
3.	0 4 5	6	1 1 0 0	0 4 5	6 1 1 9 9	
4.	0 5 0	1	0 1 0 0	0 5 6	0 0 2 9 9	1

1. Obtain card images for 1974 for 04030/.
2. Obtain card images for 1961 through 1970 for 045105.
3. Obtain card images for all years for 045611.
4. Obtain station-year blocks for all years, and for all stations in State 05. (Note that leading zeroes must be entered.)

Note: It will save processing time if the input cards (or entries from the terminal) are in ascending order.

B. Sample Run (*see p. 6 top*)

1. Obtain exclusive use of the program file.
2. Assign the *first* file from which data are to be extracted. If the files are needed, they will be dynamically assigned and freed during execution.
3. Assign a mass storage file to receive the card images and catalog it if the run terminates normally.
4. Assign a blank tape to receive the station-year blocks.

*Note: Either or both of steps 3 and 4 may be assigned to scratch files.

5. Assign internal unit number of 2 to the library tape.
6. CARDS will be referenced as file 15.
7. BLØCKS will be referenced as file 16.
8. Execute the absolute element to select the data.
9. Data cards as described in part A.
10. End of data cards.
11. Terminate the run. The mass storage file CARDS and the magnetic tape BLØCKS are now available for use by analysis programs.

IV. Listing the Card Images

If the user suspects an error in the data, the year in question may be listed for proofreading by the following sequence (see p. 6 bottom):

1. Obtain exclusive use of the program file.
2. Assign the inventory tape which contains the year(s) to be listed.
3. Assign a mass storage file to receive the card images and catalog it unconditionally.
4. Assign a scratch file for the block images.
5. Execute the absolute element to select the data.
6. Data cards as described in Part III, A.
7. End of data cards.
8. Complete the cataloging of the file containing the card images.
9. Execute the absolute element to list the cards.
10. Add the card image file to the runstream to be listed.
11. Delete the cataloged file (if no longer needed).
12. Terminate the run.

Note: Steps 9 and 10, which perform the actual list, may be accomplished more economically by the @PRT,@ELT or @ED processors, if desired.

Summary

The Fire Weather Data Library has been compiled and made available at FCCC and Colorado State University for scientists and resource managers who need historic weather data to support their predictions and decisions. Most of the data are from stations in forested and/or mountainous areas not adequately covered by the National Weather Service. These data should therefore be useful in mountain and forest meteorology research.

The Data Library is accessible to all users of the USDA computer in Fort Collins, Colo. Auxiliary

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[2] *Data format is set forth in Helfman et al. 1975 [p. G-1] and repeated in Appendix B.*

III. Obtaining Data for Analysis

```
1. @ASG,AX FIREDATALIB*PROGRAMS.
2. @ASG,A FIREDATALIB*00-04.
3. @ASG,CP CARDS.
4. @ASG,T BLOCKS.,U9V
5. @USE 2.,FIREDATALIB*00-04.
6. @USE 15.,CARDS.
7. @USE 16.,BLOCKS.
8. @XQT FIREDATALIB*PROGRAMS.GETDATA2
9.      04020574
        04040400    04041099
10. @EOF
11. @FIN
```

```
DATA SELECTION  11/04/75

FROM       TO         REEL      OUTPUT

04020574   04020574   00-04     FORMATTED CARD IMAGES, N =     165

04040400   04041099   00-04     FORMATTED CARD IMAGES, N =    3235


THERE ARE      3400 FORMATTED CARD IMAGES TOTAL ON THE FILE CREATED BY
THIS SELECTION
```

IV. Listing the Card Images

```
1. @ASG,AX FIREDATALIB*PROGRAMS.
2. @ASG,A FIREDATALIB*00-04.
3. @USE 2,FIREDATALIB*00-04.
4. @ASG,UP 15.
5. @XQT FIREDATALIB*PROGRAMS.GETDATA2
6.      04010174
        04040400    04040499
7. @EOF
8. @FREE 15.
9. @XQT FIREDATALIB*PROGRAMS.ABSLISTCARDS
10. @ADD,EP 15.
11. @DELETE 15.
12. @FIN
```

```
NUMBER  STATION                 COUNTY        STATE AGENCY   PROTECTION UNIT            LAT    LONG   SEC  TWP  RNG   ELEV  FS

050101  ROUND TOP LO            MOFFAT          CA NPS       DINOSAUR NM               40.43  108.92  25  06N 103W   8575  02
050102  ARTESIA                 MOFFAT          CO NPS       DINOSAUR NM               40.25  109.00  07  03N 103W   6000  02
050202  MORRISON CRK.           ROUTT           CO USFS      ROUTT NF                  40.22  106.78  23  03N  84W   8400  02
050203  COLUMBINE               ROUTT           CO USFS      ROUTT NF                  40.88  106.98  06  10N  85W   8500  02
050302  GOULD                   JACKSON         CO USFS      ROUTT NF                  40.53  106.03  04  06N  77W   8975  02
050402  GRAND LAKE RS           GRAND           CO NPS       ROCKY MT. NP              40.25  105.83  31  04N  75W   8576  02
050405  WINTER PARK             GRAND           CO USFS      ARAPAHO NF                39.88  105.77  10  02S  75W   9000  02
050505  RED FEATHER RS          LARIMER         CO USFS      ROOSEVELT NF              40.80  105.53  35  10N  73W   8200  02
050507  UTILITY AREA            LARIMER         CO NPS       ROCKY MT. NP              40.36  105.55  34  05N  73W   7800  02
051501  RIO BLANCO              GARFIELD        CO USFS      WHITE RVR NF              40.03  107.28  21  01N  88W   8800  02

051601  FULFORD                 EAGLE           CO USFS      WHITE RVR NF              39.52  106.67  13  06S  83W   9800  02
051602  BASALT RS               EAGLE           CO USFS      WHITE RVR NF              39.38  107.01  08  08S  86W   6624  02
051603  MINTURN                 EAGLE           CO USFS      WHITE RVR NF              39.57  106.40  36  05S  81W   7800  02
051701  DILLON RS               SUMMIT          CO USFS      ARAPAHO NF                39.62  106.05  17  05S  77W   9000  02
051801  BERTHOUD PASS           CLEAR CREEK     CO USFS      ARAPAHO NF                39.80  105.78  10  03S  75W  11314  02
051803  SQUAW MTN.              CLEAR CREEK     CO USFS      ARAPAHO NF                39.67  105.50  30  04S  72W  11475  02
051804  CORRAL CREEK            CLEAR CREEK     CO USFS      ARAPAHO NF                39.65  105.46  04  05S  72W   8100  02
051901  MT. THORODIN            GILPIN          CO USFS      ROOSEVELT NF              39.88  105.42  11  02S  72W  10500  02
052001  INTERCANYON             JEFFERSON       CO CSFS      GOLDEN DIST.              39.57  105.22  34  05S  70W   7080  02
052401  COLORADO NM             MESA            CO NPS       COLORADO NM               39.10  108.70  13  11S 102W   5800  02

052405  CURRIER                 MESA            CO USFS      GM-UNCOM NF               39.25  107.73  02  09S  93W   8000  02
052408  GRAND JUNCTION          MESA            CO BLM
052601  LEADVILLE RS            LAKE            CO USFS      SAN ISABEL NF             39.23  106.29  26  09S  80W  10200  02
052801  CRESTED BUTTE           GUNNISON        CO USFS      GUNNISON NF               38.97  106.99  03  14S  86W   9000
052802  GUNNISON                   SON                            NF                   38.53      93  02        1W
```

Figure 1.—Example of computer print-out available on fire weather stations.

programs are provided as part of the Library to aid the user in retrieving data. Software is also available to allow the user to obtain an inventory of any or all of the data tapes in the Library.

A problem that has not been adequately solved is how to provide station identification information to the users. At present, if a user wants geographical information about any of the stations in the Library, he must request the information from the authors. Figure 1 is an example of the information about each station that is available upon request.

Literature Cited

Deeming, John E., James W. Lancaster, Michael A. Fosberg, R. William Furman, and Mark J. Schroeder.
1972. National fire-danger rating system. USDA For. Serv. Res. Pap. RM-84, 165 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Furman, R. William, and Robert S. Helfman.
1973. A computer program for processing historic fire weather data for the national fire-danger rating system. USDA For. Serv. Res. Note RM-234, 12 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Helfman, Robert S., John E. Deeming, Robert J. Straub, and R. William Furman.
1975. User's guide to AFFIRMS: Time-share computerized processing for fire danger rating. USDA For. Serv. Gen. Tech. Rep. RM-15, 107 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Appendix A
States of the United States

Station numbers are always six digits: SSCCWW, where

SS represents the state number
CC represents the county number
WW represents the weather station number

00. *
01. Alabama
50. Alaska
02. Arizona
03. Arkansas
04. California
05. Colorado
06. Connecticut
07. Delaware
08. Florida
09. Georgia
49. Hawaii
10. Idaho
11. Illinois
12. Indiana
13. Iowa
14. Kansas
15. Kentucky
16. Louisiana
17. Maine
18. Maryland
19. Massachusetts
20. Michigan
21. Minnesota
22. Mississippi
23. Missouri
24. Montana
25. Nebraska
26. Nevada
27. New Hampshire
28. New Jersey
29. New Mexico
30. New York
31. North Carolina
32. North Dakota
33. Ohio
34. Oklahoma
35. Oregon
36. Pennsylvania
37. Rhode Island
38. South Carolina
39. South Dakota
40. Tennessee
41. Texas
42. Utah
43. Vermont
44. Virginia
45. Washington
46. West Virginia
47. Wisconsin
48. Wyoming

*Used only for a few National Weather Service stations not in the current 6-digit number system.

Appendix B

The Format of AFFIRMS Archived Fire Weather Data

Punch Card Format (Modified) for WS Form D-9a

Field Description	Begin Col. #	End Col. #
Station Number	1	6
Year	7	8
Month	9	10
Day	11	12
State of Weather		13
Dry-Bulb Temp. (°F)	14	16
Relative Humidity (%)	17	19
*1-Hr-T/L Moist.	20	22
Herb-Veg-Cond (Model 1)	23	24
Man-Caused-Risk	25	27
Wind Direction (8 point)		28
Wind Speed (mph)	29	31
Woody-Veg-Cond (Model 1)		32
*10-Hr-T/L Moist. (%)	33	35
*100-Hr-T/L Moist. (%)	36	38
Max. Temp (°F)	39	41
Min. Temp (°F)	42	44
Max. R.H. (%)	45	47
Min. R.H. (%)	48	50
Not Used		51
Precip. Duration	52	53
Precip. Amount (in)	54	57
Lightning Act. Level	58	60
Digit "2"		61
Model 1 I.D.		62
Secondary Models:		
Model 2 I.D.		63
Model 2 Woody		64
Model 2 Herb	65	66
Model 3 I.D.		67
Model 3 Woody		68
Model 3 Herb	69	70
Model 4 I.D.		71
Model 4 Woody		72
Model 4 Herb	73	74
Model 5 I.D.		75
Model 5 Woody		76
Model 5 Herb	77	78
**Forecast Flag		79
Region Number		80

*See paragraph 6
**1 = Forecast; 0 or blank = Observation

Explanatory Notes for Modified WS D-9a Card Format

The card images are generated by the archiving processor of the "AFFIRMS" program. Some variations from the normal Weather Service WS D-9a form have been introduced. They are described below:

1) Because all humidity entries are converted by "AFFIRMS" to relative humidity (even though the input may have been wet-bulb, dewpoint, or R.H.) only the relative humidity is available for archiving. The presence of the digit "2" in card column 61 indicates that the data in columns 17-19 are relative humidity and not wet-bulb (standard for the WS-D9a).

2) The "AFFIRMS" system permits up to 5 fuel models to be associated with any given station. A separate woody-vegetation-condition and herbaceous-vegetation-condition can be specified for each model. Because later use of this data may require these conditions (for example, if live fuels are involved), the card format has been modified to include the first model's values in the normal positions on the card (23-25 for herbaceous, 23 for woody condition). The model identifier (a letter from A through I) for the first model is then placed in column 62. The other four models have their identification herbaceous-condition, and woody-condition placed in columns 63 through 78. Subsequent processing of these card images should check for a blank Model I.D. in column 62 indicating no model specification.

3) In the Max/Min temperature and humidity fields, a value of *100* in both Max and Min indicates that *both* values were missing. Subsequent processing should make this check.

4) The Forest Service Region number (column 79-80) is included for convenience in sorting by the National Fire Danger Rating Library before distribution to regional ADP offices.

5) The wind direction 8-point code in the card images has been derived from the sorted degrees-of-the-compass value. Some stations may enter wind direction in systems other than 8 point which offer more resolution, such as 16 point or degrees-of-the-compass. Such additional resolution is, of course, lost when this conversion to 8 point is made. Missing direction is recorded in the card images as "0".

6) The 1-, 10-, and 100-hour timelag fuel moistures are only archived if actually entered (non-missing) in an observation. In all cases where these items are computed from ambient conditions, they appear in the archived records as zero or blank.

7) For the period 1973 through March 1975, "AFFIRMS" made only one consistency check on the precip. amount: values were required to be between 0 and 10.00 inches. Occasionally, field personnel would enter 9 when they should have entered .90 or .09. These three values are all valid as far as the AFFIRMS program is concerned, therefore large precipitation amounts should be viewed with suspicion for this period.

Furman, R. William, and Glen E. Brink.
1975. The national fire weather data library: What it is and how to use it. USDA For. Serv. Gen. Tech. Rep. RM-19, 8 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521.

The National Fire Weather Data Library is a collection of daily weather observations from fire weather stations across the Nation. Current data are accumulated on collection tapes, then merged onto library tapes annually. Example run streams are given for using the library on the UNIVAC 1108 computer at the Fort Collins Computer Center.

Keyword: Fire weather

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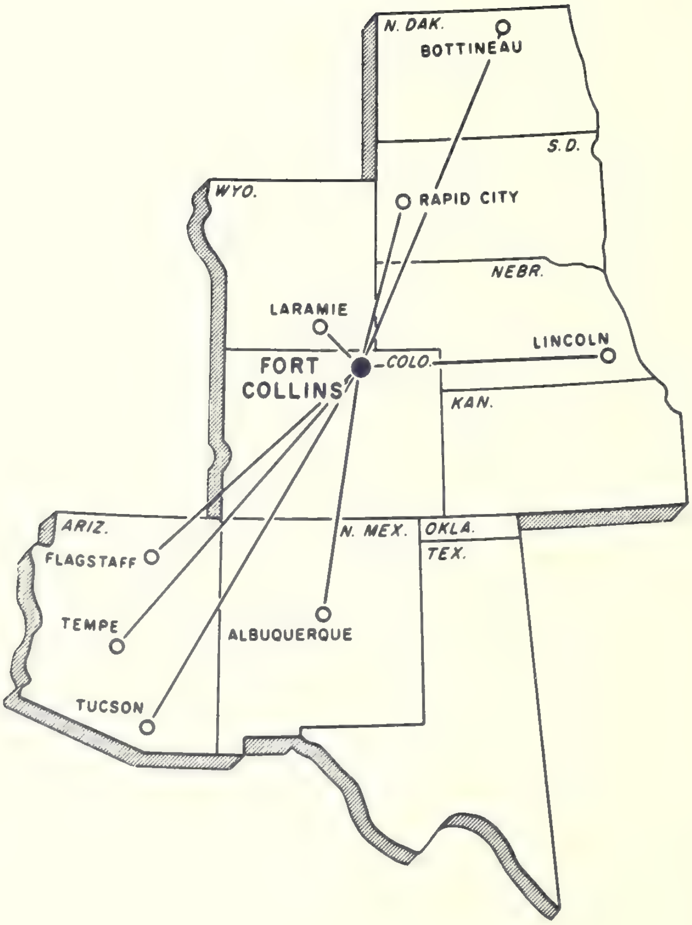
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Abstract

Nickerson, Mona F., Glen E. Brink, and Charles Feddema.
1976. Principal range plants of the central and southern Rocky Mountains: Names and symbols. USDA For. Serv. Gen. Tech. Rep. RM-20, 121 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521.

The list provides scientific names, some useful synonyms, common names (where applicable), and standard symbols for use in field records. The scientific names are generally those from manuals specified as authoritative by Forest Service policy. The list has been prepared by use of data processing equipment. Questions or suggestions should be directed to the Curator, Forest Service Herbarium, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado, 80521.

Keywords: Plant names, grasses, grasslike plants, forbs, trees, shrubs.

USDA Forest Service
General Technical Report RM-20

January 1976

PRINCIPAL RANGE PLANTS OF THE CENTRAL AND SOUTHERN ROCKY MOUNTAINS: Names and Symbols

Compiled by
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Fort Collins, Colorado

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[1] *Central headquarters and Forest Service Herbarium maintained at Fort Collins in cooperation with Colorado State University.*

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Introduction

This list is essentially an expansion of *Range Plants of Arizona and New Mexico, Names, Symbols and Notations,* which was compiled in 1958 by Elbert H. Reid and former staff members of the USDA Forest Service Herbarium. The enlarged list includes plants of interest to Forest Service personnel as indicated primarily by collections from Arizona, New Mexico, and Colorado; some from Wyoming and South Dakota; and a few from adjacent areas.

The list provides scientific names, some useful synonyms, common names (where available) and standard symbols for use in field records. The scientific names are generally those from the manuals specified as authoritative by Forest Service policy except where conflict is encountered. In a few instances, the scientific names are from more recent manuals, and are included as a reference to names most likely to be encountered in publications not of Forest Service origin.

The abbreviated form of author citation has been used for names originated by one author but published in the work of another. For most synonyms, only a single author is cited. This is the original author if the name has not changed, or the author of a new combination if one has been made. For a few synonyms having some current usage, the author citations consist of both original and combining authors, and can be used in this form.

The common names listed in the column under "accepted" are preferable, and are generally from Kelsey and Dayton (1942). The second column of common names contains those occasionally encountered, mostly regionally. In a few instances, a common name has been suggested and is indicated by a footnote.

Symbols used in this list (coordinated with those of the 1958 list cited above) consist of four letters for genera and species, and five letters for varieties. They are formed as follows:

1. For genera, the first four letters are used and all letters are capitalized.
2. For species, the first two letters of the generic name and the first two letters of the species name are used, but only the first letter is capitalized.
3. For varieties, the first two letters of the generic name, the first two letters of the species name, and the first letter of the varietal name are used; only the first letter is capitalized.
4. Where duplication of symbols occurs, numbers have been assigned to differentiate between these. The number becomes part of the symbol.

Notations used in the list are as follows:

1. Generic symbols and names are printed in boldface type.
2. Species names are indented under the generic name.
3. Varieties are indented under the specific pithet.
4. Forms are indicated by "forma" before the form name.
5. Synonyms are indented under the name to which they apply, and are indicated by the equal sign (=).

The list has been prepared by the use of data processing equipment which will facilitate its easy modification and periodic revision. We urge users to submit suggestions for change or modification, or questions concerning individual entries, to the Curator of the Forest Service Herbarium, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado, 80521.

Principal Sources Consulted

Correll, D. S., and M. C. Johnston.
1970. Manual of the vascular plants of Texas. 1881 p. Tex. Res. Found., Renner.

Cronquist, A., A. H. Holmgren, N. H. Holmgren, and J. L. Reveal.
1972. Intermountain flora. Vol. 1, 270 p. N.Y. Bot. Gard., and Hofner Publ. Co., N.Y.

Harrington, H. D.
1954. Manual of the plants of Colorado. 666 p. Sage Books, Denver, Colo.

Hitchcock, A. S., and A. Chase.
1951. Manual of the grasses of the United States. U.S. Dep. Agric. Misc. Publ. 200, 1051 p.

Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. W. Thompson.
1955-1969. Vascular plants of the Pacific Northwest. Parts 1-5. Univ. Wash. Press, Seattle.

Kearney, T. H., and R. H. Peebles.
1960. Arizona flora. Ed. 2, with Suppl. by J. T. Howell and E. McClintock. 1085 p. Univ. Calif. Press, Berkeley.

Kelsey, H. P., and W. A. Dayton.
1942. Standardized plant names. Ed. 2. 675 p. J. Horace McFarland Co., Harrisburg, Pa.

Little, E. L., Jr.
1953. Check list of native and naturalized trees of the United States. U.S. Dep. Agric., Agric. Handb. 41, 472 p.

Munz, P. A.
1959. A California flora. 1681 p. Univ. Calif. Press, Berkeley.

Munz, P. A.
1973. Supplement to a California flora. 224 p. Univ. Calif. Press, Berkeley.

Tidestrom, I., and T. Kittell.
1941. Flora of Arizona and New Mexico. 827 p. The Catholic Univ. Am. Press, Wash., D.C.

Weber, W. A.
1972. Rocky Mountain flora. 438 p. Colo. Assoc. Univ. Press, Boulder.

Grasses

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
AEGO	***Aegopogon***		
Aete*	*tenellus* (DC.) Trin.		relaxgrass
AGRO1	***Agropyron***	**wheatgrass**	
Agal1	*albicans* Scribn. + Smith	Montana wheatgrass	
Agba	*bakeri* E. Nels.	Baker wheatgrass	
Agcr	*cristatum* (L.) Gaertn.	fairway wheatgrass[1]	crested wheatgrass
Agda	*dasystachyum* (Hook.) Scribn.	thickspike wheatgrass	
Agde1	*desertorum* (Fisch.) Schult.	crested wheatgrass	desert wheatgrass
Aggr1	*griffithsii* Piper	Griffiths wheatgrass	
Agin1	*inerme* (Scribn. + Smith) Rydb. = *A. spicatum* var. *inerme* Heller	beardless bluebunch wheatgrass	
Agin	*intermedium* (Host) Beauv.	intermediate wheatgrass	
Agla	*latiglume* (Scribn. + Smith) Rydb. = *A. violaceum* var. *latiglume* Scribn. + Smith	subalpine wheatgrass	
Agps	*pseudorepens* Scribn. + Smith	false quackgrass	
Agre	*repens* (L.) Beauv.	quackgrass	
Agri	*riparium* Scribn. + Smith	streambank wheatgrass	
Agsa1	*saundersii* (Vasey) Hitchc. = *Elymus saundersii* Vasey	Saunders wheatgrass	
Agsa2	*saxicola* (Scribn. + Smith) Piper	foxtail wheatgrass	
Agsc2	*scribneri* Vasey	Scribner wheatgrass	
Agsm	*smithii* Rydb.	bluestem wheatgrass	western wheatgrass
Agsmm	*molle* (Scribn. + Smith) M. E. Jones		
Agsmp	*palmeri* (Scribn. + Smith) Heller		
Agsp	*spicatum* (Pursh) Scribn. + Smith	bearded bluebunch wheatgrass	bluebunch wheatgrass
Agsu	*subsecundum* (Link) Hitchc. = *A. caninum* of some authors, NOT (L.) Beauv.	bearded wheatgrass	
Agtr1	*trachycaulum* (Link) Malte = *A. pauciflorum* (Schwein.) Hitchc., NOT Schur = *A. tenerum* Vasey = *A. violaceum* var. *major* Vasey	slender wheatgrass	
Agtr2	*trichophorum* (Link) Richt.	pubescent wheatgrass[2]	stiffhair wheatgrass
AGRO2	***Agrostis***	**bentgrass**	
Agal	*alba* L.[3]	redtop	
Agex	*exarata* Trin. = *A. asperifolia* Trin. = *A. scouleri* Trin.	spike bentgrass	spike bent
Aghu	*humilis* Vasey	alpine bentgrass	
Agid	*idahoensis* Nash	Idaho bentgrass	
Agpa1	*palustris* Huds. = *A. alba* of some authors, NOT L.	creeping bentgrass	creeping bent
Agpe	*perennans* (Walt.) Tuckerm. = *A. oreophila* Trin.	autumn bentgrass[4]	

*Annual grass

[1] Fairway wheatgrass is the recommended common name for *Agropyron cristatum;* crested wheatgrass the recommended name for *Agropyron desertorum.*

[2] Pubescent wheatgrass is the common name used in the USDA (FS) Agriculture Handbook No. 58 for *Agropyron trichophorum.*

[3] See also *A. palustris.*

[4] Autumn bentgrass is not attributed to the western United States. Material from our area so labeled should be checked.

Grasses (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
Agro	*rossae* Vasey[5]	Ross bentgrass	
Agsc1	*scabra* Willd.	rough bentgrass[6]	winter bent
Agscg	*geminata* (Trin.) Swall. = *A. hiemalis* var. *geminata* Hitchc.	Arctic rough ticklegrass	
Agse	*semiverticillata* (Forsk.) C. Christ.	water bentgrass	water bent
Agte	*tenuis* Sibth.	colonial bentgrass	
Agth	*thurberiana* Hitchc.	Thurber bentgrass	
Agva	*variabilis* Rydb. = *A. rossae* of some authors, NOT Vasey		
ALOP	***Alopecurus***	**foxtail**	
Alae	*aequalis* Sobol. = *A. aristulatus* Michx.	shortawn foxtail	
Alal	*alpinus* J. E. Sm.	alpine foxtail	
Alge	*geniculatus* L.	water foxtail	
Alpr	*pratensis* L.	meadow foxtail	
ANDR1	***Andropogon***	**bluestem**	**beardgrass, bluejoint gra**
Anba	*barbinodis* Lag.	cane bluestem	
Anci	*cirratus* Hack.	Texas bluestem	
Ange	*gerardii* Vitman = *A. furcatus* Muhl.	big bluestem	
Angl1	*glomeratus* (Walt.) B.S.P.	bushy bluestem	bushy beardgrass
Anha	*hallii* Hack.	sand bluestem	
Anhi	*hirtiflorus* (Nees) Kunth		
Anhif	*feensis* (Fourn.) Hack.	SantaFe bluestem	Santa Fe bluestem
Anis	*ischaemum* L.	EastIndies bluestem	Turkestan bluest
Ansa	*saccharoides* Swartz = *A. argenteus* DC. = *A. laguroides* DC. = *A. torreyanus* Steud.	silver bluestem	silver beardgrass
Ansc	*scoparius* Michx.	little bluestem	
ARIS	***Aristida***	**threeawn**	**dogtown grass, poverty gras needlegrass**
Arad*	*adscensionis* L.	sixweeks threeawn	
Arar1	*arizonica* Vasey	Arizona threeawn	
Arba	*barbata* Fourn.	Havard threeawn	
Arca1	*californica* Thurb.	Mohave threeawn	
Ardi	*divaricata* Willd. = *A. palmeri* Vasey	poverty threeawn	
Arfe1	*fendleriana* Steud.	Fendler threeawn	
Argl1	*glabrata* (Vasey) Hitchc.	SantaRita threeawn	
Argl2	*glauca* (Nees) Walp. = *A. reverchonii* Vasey	blue threeawn	reverchon three
Arlo1	*longiseta* Steud.	red threeawn	
Arlor	*robusta* Merr.		
Arol*	*oligantha* Michx.	prairie threeawn	
Aror	*orcuttiana* Vasey	single threeawn	beggarstick
Arpa1	*pansa* Woot. + Standl.	Wooton threeawn	
Arpu1	*purpurea* Nutt.	purple threeawn	
Arte1	*ternipes* Cav.	spidergrass	
ARRH	***Arrhenatherum***	**oatgrass**	
Arel	*elatius* (L.) Presl	tall oatgrass	

[5] See also *A. variabilis* Rydb. True Ross bentgrass is a rare annual of alkaline sites in Yellowstone National Park.

[6] The common name of rough bentgrass is suggested for *Agrostis scabra* to distinguish it from winter bentgrass (*A. hiemalis*) with which it has been confused in some manuals.

Grasses (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
AVEN	***Avena***	**oat**	
Avba*	*barbata* Brot.	slender oat	
Avfa*	*fatua* L.	wild oat	
Avsa*	*sativa* L.	common oat	
BECK	***Beckmannia***	**sloughgrass**	
Besy*	*syzigachne* (Steud.) Fern. = *B. erucaeformis* of some authors, NOT (L.) Host	American sloughgrass	
BLEP	***Blepharoneuron***	**dropseed**	
Bltr	*tricholepis* (Torr.) Nash	pine dropseed	beardless bunchgrass
BOUT	***Bouteloua***	**grama**	
Boar*	*aristidoides* (H.B.K.) Griseb.	needle grama	
Boba*	*barbata* Lag.	sixweeks grama	
Bobr	*breviseta* Vasey	gyp grama	
Boch	*chondrosioides* (H.B.K.) Wats.	sprucetop grama	
Bocu	*curtipendula* (Michx.) Torr.	sideoats grama	
Boel	*eludens* Griffiths	SantaRita grama	
Boer	*eriopoda* (Torr.) Torr.	black grama	woollyfoot grama
Bofi	*filiformis* (Fourn.) Griffiths	slender grama	
Bogr	*gracilis* (H.B.K.) Steud. = *B. oligostachya* Gray	blue grama	
Bohi	*hirsuta* Lag.	hairy grama	
Bopa*	*parryi* (Fourn.) Griffiths	Parry grama	
Bora	*radicosa* (Fourn.) Griffiths	purple grama	
Boro	*rothrockii* Vasey	Rothrock grama	
Bosi*	*simplex* Lag.	mat grama	
Botr	*trifida* Thurb.	red grama	
BROM	***Bromus***	**brome**	**bromegrass**
Bran	*anomalus* Fourn. = *B. porteri* Nash	nodding brome	Porter brome
Branl	*lanatipes* (Shear) Hitchc.	woolly nodding brome	
Brbr1	*breviaristatus* Buckl.	slimleaf brome	
Brbr2*	*brizaeformis* Fisch. + Mey.	rattle brome	rattlesnake chess
Brca1	*carinatus* H. + A.	mountain brome	California brome
Brca2*	*catharticus* Vahl	rescue brome	rescuegrass
Brci	*ciliatus* L. = *B. richardsonii* Link.	fringed brome	Richardson brome
Brco*	*commutatus* Schrad.	hairy brome	
Brer1	*erectus* Huds.	meadow brome	erect brome
Brfr1	*frondosus* (Shear) Woot. + Standl.	weeping brome	
Brin1	*inermis* Leyss.	smooth brome	Hungarian brome
Brja*	*japonicus* Thunb.	Japanese brome	Japanese chess
Brla	*laevipes* Shear	chinook brome	
Brma	*marginatus* Nees		mountain brome
Brmo*	*mollis* L.	soft brome	soft chess
Brpo	*polyanthus* Scribn.		foothills brome
Brpu1	*pumpellianus* Scribn.	Pumpelly brome	
Brpu	*purgans* L.	Canada brome	
Brra*	*racemosus* L.	bald brome	
Brri*	*rigidus* Roth	ripgut brome	ripgut grass
Brru1*	*rubens* L.	foxtail brome	foxtail chess, red brome
Brte1*	*tectorum* L.	cheatgrass brome	downy brome, cheatgrass, downy chess
Brteg*	*glabratus* Spenner		
Brte2	*texensis* (Shear) Hitchc.	Texas brome	
BUCH	***Buchloe***	**buffalograss**	
Buda	*dactyloides* (Nutt.) Engelm. = *Bulbilis dactyloides* Kuntze	buffalograss	

Grasses (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
CALA1	***Calamagrostis***	**reedgrass**	
Caca	*canadensis* (Michx.) Beauv.	bluejoint reedgrass	
Cain1	*inexpansa* Gray = *C. hyperborea* of some authors, NOT Lange	northern reedgrass	
Capu1	*purpurascens* R. Br.	purple pinegrass	
Caru1	*rubescens* Buckl.	pinegrass	
Casc	*scopulorum* M. E. Jones	Jones reedgrass	
Casc1	*scribneri* Beal	Scribner reedgrass	
CALA3	***Calamovilfa***	**sandreed**	
Cagi	*gigantea* (Nutt.) Scribn. + Merr.	big sandreed	giant reedgrass
Calo	*longifolia* (Hook.) Scribn.	prairie sandreed	
CATA	***Catabrosa***	**brookgrass**	
Caaq1	*aquatica* (L.) Beauv.	brookgrass	
CENC	***Cenchrus***	**sandbur**	
Cepa1*	*pauciflorus* Benth. = *C. tribuloides* of some authors, NOT L.	mat sandbur	field sandbur
CHLO	***Chloris***	**chloris**	**windmillgrass**
Chve	*verticillata* Nutt.	tumble windmillgrass	windmillgrass
Chvi1*	*virgata* Swartz = *C. elegans* H.B.K.	showy chloris	feather fingergr
CINN	***Cinna***	**woodreed**	
Cila2	*latifolia* (Trev.) Griseb.	drooping woodreed	
CYNO1	***Cynodon***	**dogtoothgrass**	
Cyda	*dactylon* (L.) Pers.	Bermudagrass	
DACT	***Dactylis***	**orchardgrass**	**cocksfoot**
Dagl	*glomerata* L.	orchardgrass	
DANT	***Danthonia***	**danthonia**	**oatgrass**
Daca	*californica* Boland.	California danthonia	
Dain	*intermedia* Vasey	timber danthonia	timber oatgrass
Dapa1	*parryi* Scribn.	Parry danthonia	Parry oatgrass
Dasp1	*spicata* (L.) R. + S.	poverty danthonia	poverty oatgrass
Daun	*unispicata* (Thurb.) Macoun	onespike danthonia	
DESC2	***Deschampsia* = *Aira*, in part**	**hairgrass**	
Deat	*atropurpurea* (Wahl.) Scheele	mountain hairgrass	
Deca	*caespitosa* (L.) Beauv.	tufted hairgrass	
Deda*	*danthonioides* (Trin.) Benth.	annual hairgrass	
Deel	*elongata* (Hook.) Benth.	slender hairgrass	
DIGI	***Digitaria***	**crabgrass**	**fingergrass**
Disa*	*sanguinalis* (L.) Scop. = *Syntherisma sanguinalis* Dulac	hairy crabgrass	
DIST	***Distichlis***	**saltgrass**	
Dist	*stricta* (Torr.) Rydb.	inland saltgrass	desert saltgrass
ECHI1	***Echinochloa***	**cockspur**	
Ecco*	*colonum* (L.) Link	junglerice	shanwamillet
Eccr*	*crusgalli* (L.) Beauv.	barnyardgrass	
Eccrz*	*zelayensis* (H.B.K.) Hitchc.	alkali barnyardgrass	
ELEU	***Eleusine***		
Elin*	*indica* (L.) Gaertn.	goosegrass	
ELYM	***Elymus***	**wildrye**	
Elam	*ambiguus* Vasey + Scribn.	Colorado wildrye	
Elca	*canadensis* L.	Canada wildrye	

Grasses (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Elci	*cinereus* Scribn. + Merr.	Pacific giant wildrye	
	= *E. condensatus* of some authors, NOT Presl		
	= *E. condensatus* var. *pubens* Piper		
Elco	*condensatus* Presl	giant wildrye	
Elgl	*glaucus* Buckl.	blue wildrye	
Elin1	*innovatus* Beal	fuzzyspike wildrye	
Elju	*junceus* Fisch.	Russian wildrye	
Elma	*macounii* Vasey	Macoun wildrye	
Elsa	*salinus* M.E. Jones	Salina wildrye	
Eltr	*triticoides* Buckl.	creeping wildrye	beardless wildrye
Elvi	*virginicus* L.	Virginia wildrye	
ELYO	***Elyonurus***	**balsamscale**	
Elba	*barbiculmis* Hack.	woolspike balsamscale	woolspike
ENNE	***Enneapogon***		
Ende	*desvauxii* Beauv.	spike pappusgrass	American nine-plume
ERAG	***Eragrostis***	**lovegrass**	
Erch1	*chloromelas* Steud.[7]	Boer lovegrass	
Erci2*	*cilianensis* (All.) Lutati	stinkgrass	
	= *E. major* Host		
	= *E. megastachya* Link		
Ercu	*curvula* (Schrad.) Nees	weeping lovegrass	
Erdi1*	*diffusa* Buckl.	spreading lovegrass	
Erer	*erosa* Scribn.	Chihuahua lovegrass	
Erin1	*intermedia* Hitchc.	plains lovegrass	
Erle	*lehmanniana* Nees	Lehmann lovegrass	
Erlu*	*lutescens* Scribn.	sixweeks lovegrass	
Erme*	*mexicana* (Hornem.) Link	Mexican lovegrass	
Erne*	*neomexicana* Vasey	NewMexico lovegrass	
Erox	*oxylepis* (Torr.) Torr.[8]	red lovegrass	
	= *E. secundiflora* of some authors, NOT Presl		
Erpe*	*pectinacea* (Michx.) Nees[9]	Carolina lovegrass	
	= *E. caroliniana* (Spreng.) Scribn.		
Erpi*	*pilosa* (L.) Beauv.	India lovegrass	
Erre1	*refracta* (Muhl.) Scribn.[10]	coastal lovegrass	
Ersp1	*spectabilis* (Pursh) Steud.	purple lovegrass	
Ertr1	*trichodes* (Nutt.) Wood	sand lovegrass	
ERIO4	***Eriochloa***	**cupgrass**	
Ergr*	*gracilis* (Fourn.) Hitchc.	southwestern cupgrass	
FEST	***Festuca***	**fescue**	**mountain bunchgrass**
Fear1	*arizonica* Vasey	Arizona fescue	pine bunchgrass, white bunchgrass

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[7] There is, at present, some question as to whether this name and that of *E. curvula* are usually assigned to the proper plants.

[8] *E. oxylepis* is a perennial lovegrass of sandy or dry soils, native to eastern Colorado; it has been confused with *E. secundiflora* Presl which is a rare Mexican species. Specimens from this area labeled *E. secundiflora* should be checked.

[9] True Carolina lovegrass is an annual rare in the western states; it resembles the weedy annual India lovegrass, --*E. pilosa* (L.) Beauv., introduced from Europe. Another complication is that the name *Eragrostis pectinacea* has been misapplied to purple lovegrass, --*E. spectabilis* (Pursh) Steud, which is a perennial, usually tufted lovegrass ranging from Maine south to Florida and west to Minnesota and Arizona.

[10] This is a perennial of low, sandy soil of the coastal plain (Delaware, south to Florida, Arkansas and eastern Texas). Specimens from our area called *E. refracta* should be checked.

Grasses (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Fear2	*arundinacea* Schreb.	reed fescue	Alta fescue,[11] Kentucky fesc tall fescue
	= *F. elatior* var. *arundinacea* Wimm.		
Feel	*elatior* L.	meadow fescue	
	= *F. pratensis* Huds.		
Feid	*idahoensis* Elmer	Idaho fescue	
	= *F. ingrata* Rydb.		
	= *F. ovina* var. *ingrata* Beal		
Feme*	*megalura* Nutt.	foxtail fescue	
Feoc*	*octoflora* Walt.	sixweeks fescue	
Feoch*	*hirtella* Piper	hairy sixweeks fescue	
Feov	*ovina* L.	sheep fescue	
	= *F. ovina* var. *pseudovina* Hack.		
	= *F. saximontana* Rydb.		
Feovb	*brachyphylla* (Schult.) Piper	alpine fescue	
	= *F. brachyphylla* Schult.		
Fepa*	*pacifica* Piper	Pacific fescue	
Feru1	*rubra* L.	red fescue	
Ferul	*lanuginosa* Mert. + Koch	hairyscale red fescue	
Fesc	*scabrella* Torr.	rough fescue	
	= *F. halli* Piper		
Feso	*sororia* Piper	ravine fescue	
Feth	*thurberi* Vasey	Thurber fescue	
Fevi	*viridula* Vasey	green fescue	greenleaf fescue
GLYC	***Glyceria* = *Panicularia***	**mannagrass**	
Glbo	*borealis* (Nash) Batchelder	northern mannagrass	
	= *P. borealis* Nash		
Glel	*elata* (Nash) M. E. Jones	tall mannagrass	
	= *P. elata* Nash		
	= *P. nervata* ssp. *elata* Piper		
Glgr	*grandis* Gray	American mannagrass	
	= *G. americana* Pammel		
	= *P. americana* Macm.		
	= *P. grandis* Nash		
Glpa	*pauciflora* Presl	weak mannagrass	
	= *P. pauciflora* Kuntze		
Glst	*striata* (Lam.) Hitchc.	fowl mannagrass	
	= *G. neogaea* Steud.		
	= *G. nervata* Trin.		
	= *G. striata* var. *stricta* Fern.		
	= *P. nervata* Kuntze		
	= *P. striata* Hitchc.		
HELI5	***Helictotrichon* = *Avena*, in part**		
Heho1	*hookeri* (Scribn.) Henr.	spike oat	
	= *Avena hookeri* Scribn.		
Hemo	*mortonianum* (Scribn.) Henr.	alpine oat	
	= *Avena mortoniana* Scribn.		
HESP	***Hesperochloa***	**spikefescue**	
Heki	*kingii* (Wats.) Rydb.	spikefescue	
	= *Festuca confinis* Vasey		
	= *Festuca kingii* Cassidy		
HETE1	***Heteropogon***	**tanglehead**	
Heco1	*contortus* (L.) R. + S.	tanglehead	
HIER1	***Hierochloe***	**sweetgrass**	

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[11] Alta fescue is a strain of *Festuca arundinacea*.

Grasses (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Hiod	*odorata* (L.) Beauv.	sweetgrass	
	= *Savastana odorata* Scribn.		
	= *Torresia odorata* Hitchc.		
HILA	***Hilaria* = *Pleuraphis***	**hilaria**	
Hibe	*belangeri* (Steud.) Nash	curlymesquite	creepingmesquite
Hija	*jamesii* (Torr.) Benth.	galleta	
	= *P. jamesii* Torr.		
Himu	*mutica* (Buckl.) Benth.	tobosa	tobosa-grass
	= *P. mutica* Buckl.		
Hiri	*rigida* (Thurb.) Scribn.	big galleta	desert galleta
HOLC	***Holcus* = *Notholcus***	**velvetgrass**	
Hola	*lanatus* L.	common velvetgrass	velvetgrass
HORD	***Hordeum***	**barley**	**foxtail, squirreltail**
Hobr	*brachyantherum* Nevski	northern meadow barley[12]	meadow barley
	= *H. nodosum* of some authors, NOT L.		
	= *H. nodosum* var. *boreale* Hitchc.		
	= *H. boreale* Scribn. + Smith, NOT Gandog.		
Hoju	*jubatum* L.	foxtail barley	
Hojuc	*caespitosum* (Scribn.) Hitchc.	bobtail barley	
	= *H. caespitosum* Scribn.		
Hole*	*leporinum* Link		mouse barley
Hopu*	*pusillum* Nutt.	little barley	
KOEL	***Koeleria***	**koeleria**	
Kocr	*cristata* Pers.	prairie junegrass	junegrass
	= *K. macrantha*(Ledeb.) Schultes		
LAMA	***Lamarckia***	**goldentop**	
Laau*	*aurea* (L.) Moench	goldentop	
LEER	***Leersia***	**cutgrass**	
Leor	*oryzoides* (L.) Swartz	rice cutgrass	
LEPT	***Leptochloa***	**sprangletop**	
Ledu	*dubia* (H.B.K.) Nees	green sprangletop	
Lefa*	*fascicularis* (Lam.) Gray	bearded sprangletop	
Lefi*	*filiformis* (Lam.) Beauv.	red sprangletop	
Leun*	*uninervia* (Presl) Hitchc. + Chase	Mexican sprangletop	
LEPT2	***Leptoloma***		
Leco	*cognatum* (Schult.) Chase	fall witchgrass	
LOLI	***Lolium***	**ryegrass**	
Lomu	*multiflorum* Lam.	Italian ryegrass	
Lope	*perenne* L.	perennial ryegrass	
LYCU	***Lycurus***	**wolftail**	
Lyph	*phleoides* H.B.K.	wolftail	Texas-timothy
MELI1	***Melica***	**melic**	**melicgrass, oniongrass**
Mebu	*bulbosa* Port. + Coult.	oniongrass	
	= *M. bella* Piper		
Meni	*nitens* (Scribn.) Piper	threeflower melic	
Mepo	*porteri* Scribn.	Porter melic	
Mesp3	*spectabilis* Scribn.	showy oniongrass	purple oniongrass
MUHL	***Muhlenbergia***	**muhly**	
Muan	*andina* (Nutt.) Hitchc.	foxtail muhly	
	= *M. comata* Benth.		
Muar3	*arenacea* (Buckl.) Hitchc.	ear muhly	

[12] Suggested common name.

Grasses (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Muar1	*arenicola* Buckl.	sand muhly	
Muar2	*arizonica* Scribn.	Arizona muhly	
Muas	*asperifolia* (Nees + Mey.) Parodi = *Sporobolus asperifolius* Nees	alkali muhly	
Mubr*	*brevis* Goodding = *M. depauperata* of some authors NOT Scribn.		
Mucu	*cuspidata* (Torr.) Rydb.	stonyhills muhly	plains muhly
Mude*	*depauperata* Scribn.	sixweeks muhly	
Mudu1	*dubia* Fourn.	pine muhly	
Mudu2	*dumosa* Scribn.	bamboo muhly	
Muem	*emersleyi* Vasey	bullgrass	
Mufi1	*filiculmis* Vasey	slimstem muhly	
Mufi2*	*filiformis* (Thurb.) Rydb.	pullup muhly	
Mulo	*longiligula Hitchc.*	longtongue muhly	
Mumi*	*minutissima* (Steud.) Swall. = *Sporobolus microspermus* of Ed. 1, Grass Manual = *Sporobolus minutissimus* Hitchc.	littleseed muhly	
Mumo1	*montana* (Nutt.) Hitchc.	mountain muhly	
Mumo2	*monticola* Buckl.	mesa muhly	
Mumu	*mundula* I. M. Johnst.[13]		
Mupa	*pauciflora* Buckl.	NewMexico muhly	
Mupo2	*polycaulis* Scribn.	cliff muhly	
Mupo1	*porteri* Scribn.	bush muhly	hoegrass, black grama[14]
Mupu	*pungens* Thurb.	sandhill muhly	
Mura1	*racemosa* (Michx.) B.S.P.	green muhly	
Mure	*repens* (Presl) Hitchc.	red muhly	creeping muhly
Muri1	*richardsonis* (Trin.) Rydb. = *M. squarrosa* Rydb.	mat muhly	
Muri3	*rigens* (Benth.) Hitchc.	deergrass	
Muri2	*rigida* (H.B.K.) Kunth	purple muhly	
Muse	*setifolia* Vasey	curlyleaf muhly	
Muth	*thurberi* Rydb.	Thurber muhly	
Muto	*torreyi* (Kunth) Bush = *M. gracillima* Torr.	ring muhly	
Muut	*utilis* (Torr.) Hitchc.	aparejograss	
Muvi	*virescens* (H.B.K.) Kunth	screwleaf muhly	
Muwo*	*wolfii* (Vasey) Rydb.	red muhly	
Muwr	*wrightii* Vasey	spike muhly	
MUNR	***Munroa***	**false buffalograss**	
Musq*	*squarrosa* (Nutt.) Torr.	false buffalograss	
ORYZ	***Oryzopsis***	**ricegrass**	
Oras	*asperifolia* Michx.	roughleaf ricegrass	
Orex	*exigua* Thurb.	little ricegrass	
Orhy	*hymenoides* (R. + S.) Ricker	Indian ricegrass	
Ormi	*micrantha* (Trin. + Rupr.) Thurb.	littleseed ricegrass	
PANI	***Panicum***	**panicum, witchgrass**	**panicgrass**
Paar*	*arizonicum* Scribn. + Merr.	Arizona panicum	
Pabu	*bulbosum* H.B.K.	bulb panicum	
Pabum	*minus Vasey*	little bulb panicum	
Paca*	*capillare* L.	common witchgrass	witchgrass
Pacao*	*occidentale* Rydb. = *P. barbipulvinatum* Nash	cushion witchgrass	
Pafa*	*fasciculatum* Swartz	browntop panicum	

[13] Doubtfully distinct from *M. rigens*, the accepted common name of which is deergrass.

[14] Frequently called black grama in grazing literature, although it is neither a grama nor a close relative of the gramas.

Grasses (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
Pafar*	*reticulatum* (Torr.) Beal		browntop panicum
Paha	*hallii* Vasey	Halls panicum	
Pahi*	*hirticaule* Presl	roughstalk witchgrass	
Pahu	*huachucae* Ashe	Huachuca panicum	
Pale	*leibergii* (Vasey) Scribn. = *P. scribnerianum* var. *leibergii* Scribn.	Leiberg panicum	
Pami*	*miliaceum* L.	proso	broomcorn millet
Paob	*obtusum* *H.B.K.*	vine-mesquite	
Pape	*perlongum* Nash		
Pasc	*scribnerianum* Nash	Scribner panicum	
Pavi	*virgatum* L.	switchgrass	
Pawi	*wilcoxianum* Vasey	Wilcox panicum	
PAPP	***Pappophorum***	**pappusgrass**	
Pamu	*mucronulatum* Nees	whiplash pappusgrass	feather pappusgrass
PASP	***Paspalum***	**paspalum**	
Padi	*distichum* L.	knotgrass	
Past	*stramineum* Nash	sand paspalum	
PHAL	***Phalaris***	**canarygrass**	
Phar	*arundinacea* L.	reed canarygrass	
Phca1*	*canariensis* L.	canarygrass	
PHLE	***Phleum***	**timothy**	
Phal	*alpinum* L.	alpine timothy	
Phpr	*pratense* L.	timothy	
PHRA	***Phragmites***	**reed**	
Phco	*communis* Trin.	common reed	
PIPT	***Piptochaetium***		
Pifi	*fimbriatum* (H.B.K.) Hitchc. = *Oryzopsis fimbriata* Hemsl.	pinyon ricegrass	
POA	***Poa***	**bluegrass**	
Poal1	*alpina* L.	alpine bluegrass	
Poam	*ampla* Merr. = *P. confusa* Rydb.	big bluegrass	
Poan1*	*annua* L.	annual bluegrass	
Poar2	*arctica* R. Br. = *P. alpicola* Nash = *P. aperta* Scribn. + Merr. = *P. grayana* Vasey = *P. longipila* Nash	arctic bluegrass	
Poar1	*arida* Vasey	plains bluegrass	
Pobi1*	*bigelovii* Vasey + Scribn.	Bigelow bluegrass	
Pobu	*bulbosa* L.	bulbous bluegrass	
Poca	*canbyi* (Scribn.) Piper = *P. laevigata* Scribn. = *P. lucida* Vasey	Canby bluegrass	
Poco1	*compressa* L.	Canada bluegrass	
Pocu1	*curta* Rydb.	Wasatch bluegrass	
Pocu	*cusickii* Vasey = *P. idahoensis* Beal = *P. nematophylla* Rydb.	Cusick bluegrass	
Poep	*epilis* Scribn. = *P. cusickii* var. *epilis* (Scribn.) C.L. Hitchc. = *P. paddensis* Williams	skyline bluegrass	

Grasses (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
Pofe	*fendleriana* (Steud.) Vasey	mutton bluegrass	muttongrass, Fendle bluegrass
	= *P. brevipaniculata* Scribn. + Williams		
	= *P. longepedunculata* Scribn		
Pogl2	*glauca* Vahl	Greenland bluegrass	
Pogl1	*glaucifolia* Scribn. + Williams		
Pogr1	*gracillima* Vasey	slender bluegrass	
	= *P. alcea* Piper		
	= *P. invaginata* Scribn. + Williams		
	= *P. saxatilis* Scribn. + Williams		
Poin1	*interior* Rydb.	inland bluegrass	
Poju	*juncifolia* Scribn.	alkali bluegrass	
Pole	*leptocoma* Trin.	bog bluegrass	
Pole1	*lettermanii* Vasey	letterman bluegrass	
Polo	*longiligula* Scribn. + Williams	longtongue mutton bluegrass	longtongue bluegra
Pone1	*nemoralis* jl.	wood bluegrass	
Pone2	*nervosa* (Hook.) Vasey	Wheeler bluegrass	
	= *P. olneyae* Piper		
	= *P. vaseyana* Scribn.		
	= *P. wheeleri* Vasey		
Pone	*nevadensis* Scribn.	Nevada bluegrass	
Pooc	*occidentalis* Vasey	NewMexico bluegrass	
Popa	*palustris* L.	fowl bluegrass	
	= *P. crocata* Michx.		
	= *P. triflora* Gilib.		
Popa1	*pattersonii* Vasey	Patterson bluegrass	
Popr	*pratensis* L.	Kentucky bluegrass	
Pore	*reflexa* Vasey + Scrib.	nodding bluegrass	
Poru	*rupicola* Nash	timberline bluegrass	
Posc	*scabrella* (Thurb.) Vasey	pine bluegrass	
	= *P. buckleyana* Nash		
Posa1	*sandbergii* Vasey	Sandberg bluegrass	
	= *P. secunda* Presl		
Post	*stenantha* Trin.	Trinius bluegrass	
POLY	***Polypogon***	**polypogon**	
Poin2	*interruptus H.B.K.*	ditch polypogon	
Pomo*	*monspeliensis* (L.) Desf.	rabbitfoot polypogon	rabbitfoot grass
PUCC	***Puccinellia***	**alkaligrass**	
Puai	*airoides* (Nutt.) Wats. + Coult.	Nuttall alkaligrass	
	= *P. nuttalliana* (Schult.) Hitchc.		
Pudi	*distans* (L.) Parl.	weeping alkaligrass	
REDF	***Redfieldia***	**blowoutgrass**	
Refl	*flexuosa* (Thurb.) Vasey	blowoutgrass	
SCHE	***Schedonnardus***	**tumblegrass**	
Scpa	*paniculatus* (Nutt.) Trel.	tumblegrass	
SCHI1	***Schismus***		
Scba*	*barbatus* (L.) Thell.	Mediterraneangrass	
SCHI2	***Schizachne***		
Scpu	*purpurascens* (Torr.) Swall.	falsemelic	
SCLE1	***Sclerochloa***	**hardgrass**	
Scdu*	*dura* (L.) Beauv.	hardgrass	
SCLE2	***Sclerpogon***	**burrograss**	
Scbr	*brevifolius* Phil.	burrograss	
SETA	***Setaria* = *Chaetochloa***	**bristlegrass, millet**	**pigeongrass**

Grasses (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
Sege	*geniculata* (Lam.) Beauv.	knotroot bristlegrass	
Segr*	*grisebachii* Fourn.	Grisebach bristlegrass	
Seit*	*italica* (L.) Beauv.	foxtail millet	
Selu*	*lutescens* (Weigel) Hubb.	yellow bristlegrass	
	= *C. glauca* of some authors, NOT L.		
Sema	*macrostachya* H.B.K.	plains bristlegrass	
Sevi*	*viridis* (L.) Beauv.	green bristegrass	
SITA	***Sitanion***	**squirreltail**	
Sihy	*hystrix* (Nutt.) J. G. Sm.	bottlebrush squirreltail	
Siju	*jubatum* J. G. Sm.	big squirreltail	
SORG	***Sorghastrum***	**Indiangrass**	
Sonu	*nutans* (L.) Nash	yellow Indiangrass	
SORG1	***Sorghum***	**sorghum**	
Soha	*halepense* (L.) Pers.	Johnsongrass	
	= *Andropogon halepensis* Brot.		
	= *Holcus halepensis* L.		
SPAR1	***Spartina***	**cordgrass**	
Spcy	*cynosuroides* (L.) Roth[15]	big cordgrass	
Spgr	*gracilis* Trin.	alkali cordgrass	
Sppe1	*pectinata* Link	prairie cordgrass	
	= *S. cynosuroides* of some authors, NOT (L.) Roth.		
	= *S. michauxiana* Hitchc.		
SPHE	***Sphenopholis***	**wedgescale**	**wedgegrass**
Spin2	*intermedia* (Rydb.) Rydb.	slender wedgescale	slender wedgegrass
Spob	*obtusata* (Michx.) Scribn.	prairie wedgescale	prairie wedgegrass
SPOR	***Sporobolus***	**dropseed**	
Spai	*airoides* (Torr.) Torr.	alkali sacaton	
Spas	*asper* (Michx.) Kunth	tall dropseed	
Spco	*contractus* Hitchc.	spike dropseed	
Spcr	*cryptandrus* (Torr.) Gray	sand dropseed	
Spfl	*flexuosus* (Thurb.) Rydb.	mesa dropseed	
Spgi	*giganteus* Nash	giant dropseed	
Sphe	*heterolepis* (Gray) Gray	prairie dropseed	
Spin1	*interruptus* Vasey	black dropseed	
Spne1	*nealleyi* Vasey	gypgrass	Nealley dropseed
Spne2*	*neglectus* Nash	puffsheath dropseed	
Sppa*	*patens* Swall.		desert dropseed
Sppu*	*pulvinatus* Swall.		sixweeks dropseed
Spte	*texanus* Vasey	Texas dropseed	
Spva*	*vaginiflorus* (Torr.) Wood	poverty dropseed	
Spwr	*wrightii* Scribn.	sacaton	
STIP	***Stipa***	**needlegrass**	**feathergrass**
Star	*arida* M. E. Jones	Mormon needlegrass	funeral needlegrass
Stco2	*columbiana* Macoun	subalpine needlegrass	Columbia needlegrass
	= *S. minor* Scribn.		
Stcon	*nelsonii* (Scribn.) Hitchc.	big subalpine needlegrass	
	= *S. nelsonii* Scribn.		
Stco1	*comata* Trin. + Rupr.	needleandthread	

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[15] This species is normally confined to brackish marshes along the east coast (Massachusetts, Florida, Texas); specimens from our area so labeled should be checked. Probably they would be referable to *S. pectinata* Link.

Grasses (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
Stcoi	*intermedia* Scribn. + Tweedy = *S. tweedyi* Scribn. = *S. spartea* var. *tweedyi* M. E. Jones	Tweedy needlegrass	Tweedy needleandthr
Stcu	*curvifolia* Swall.	Guadalupe needlegrass	
Stem	*eminens* Cav.	southwestern needlegrass	
Stle	*lettermanii* Vasey	Letterman needlegrass	
Stlo1	*lobata* Swall.	littleawn needlegrass	
Stne	*neomexicana* (Thurb.) Scribn.	NewMexico feathergrass	
Stoc	*occidentalis* Thurb.	western needlegrass	
Stpi1	*pinetorum* M. E. Jones	pinewoods needlegrass	
Stpo	*porteri* Rydb.	Colorado needlegrass	Porter needlegrass
Stpr	*pringlei* Scribn.	Pringle needlegrass	
Stri	*richardsonii* Link	Richardson needlegrass	
Stro	*robusta* (Vasey) Scribn.	sleepygrass	
Stsc	*scribneri* Vasey	Scribner needlegrass	
Stsp1	*spartea* Trin.	porcupinegrass	
Stsp2	*speciosa* Trin. + Rupr.	desert needlegrass	
Stte	*tenuissima* Trin.	finestem needlegrass	
Stvi	*viridula* Trin.	green needlegrass	
Stwi	*williamsii* Scribn.	Williams needlegrass	
TRAC	***Trachypogon***		
Trse	*secundus* (Presl) Scribn.	crinkleawn	
TRAG	***Tragus***	**burgrass**	
Trbe*	*berteronianus* Schult.	spike burgrass	
TRIC	***Trichachne***	**cottontop**	
Trca1	*californica* (Benth.) Chase = *Trichachne saccharata* Nash	Arizona cottontop	cottontop
TRID	**Tridens** = ***Triodia***	**tridens, triodia**	**cottongrass**
Tra11	*albescens* (Vasey) Woot. + Standl.	white tridens	
Trel	*elongatus* (Buckl.) Nash	rough tridens	
Trgr	*grandiflorus* (Vasey) Woot. + Standl.	shortleaf tridens	largeflowered tridens
Trmu	*muticus* (Torr.) Nash = *Triodia mutica* Scribn.	slim tridens	
Trpi	*pilosus* (Buckl.) Hitchc. = *Triodia pilosa* (Buckl.) Merr.	hairy tridens	
Trpu	*pulchellus* (H.B.K.) Hitchc. = *Triodia pulchella* H.B.K.	fluffgrass	
TRIP2	***Triplasis***	**sandgrass**	
Trpu1*	*purpurea* (Walt.) Chapm.	purple sandgrass	
TRIS	***Trisetum***	**trisetum**	
Trin*	*interruptum* Buckl.	prairie trisetum	annual trisetum
Trmo	*montanum* Vasey	RockyMountain trisetum	mountain trisetu
Trsp	*spicatum* (L.) Richt.	spike trisetum	
Trwo	*wolfii* Vasey	Wolfs trisetum	

Grasslike Plants

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
CARE	***Carex***	**sedge**	
Caal1	*albonigra* Mack.		blackhead sedge
Caal2	*alma* Bailey		alma sedge
Caan1	*angustior* Mack.		
Caap	*aperta* Boott		
Caaq	*aquatilis* Wahl.	water sedge	
Caaqa	*altior* (Rydb.) Fern. = *C. substricta* Mack.		
Caar3	*arapahoensis* Clokey		Arapaho sedge
Caar4	*arctogena* H. Smith		
Caat4	*atherodes* Spreng.		
Caat3	*athrostachya* Olney	slenderbeak sedge	
Caat2	*atrosquama* Mack.		
Caau	*aurea* Nutt.	goldensedge	
Caba	*backii* Boott		
Cabe1	*bebbii* Olney		
Cabe	*bella* Bailey		beautiful sedge
Cabi	*bigelowii* Torr.		
Cabl	*blanda* Dewey		
Cabo	*bonplandii* Kunth		
Cabr1	*brevior* (Dewey) Mack.		
Cabr	*brevipes* W. Boott		
Caca2	*canescens* L.		pale sedge
Caca3	*capillaris* L.		
Caca4	*capitata* L.		
Caco	*concinna* R. Br.		
Cacr	*crawei* Dewey		
Cadi1	*diandra* Shrank		
Cadi	*disperma* Dewey = *C. tenella* Schkuhr		
Cado	*douglasii* Boott	Douglas sedge	
Caeb	*ebenea* Rydb.	ebony sedge	
Caeg	*egglestonii* Mack.	Eggleston sedge[16]	
Cael1	*eleocharis* Bailey	needleleaf sedge	
Cael	*elynoides* Holm		
Caen	*engelmannii* Bailey		
Cafe	*festivella* Mack. = *C. festiva* of some authors, NOT Dewey	ovalhead sedge	
Cafi	*filifolia* Nutt.	threadleaf sedge	
Cafo	*foenea* Willd. = *C. siccata* Dewey	silvertop sedge	
Cage	*geophila* Mack.		dryland sedge
Cage1	*geyeri* Boott	elk sedge	
Cagr1	*gravida* Bailey		
Cagy	*gynocrates* Wormsk.		
Caha	*haydeniana* Olney = *C. nubicola* Mack.	cloud sedge	
Cahe1	*heliophila* Mack. = *C. pennsylvanica* of some authors, NOT Lam. = *C. pennsylvanica* var. *vespertina* Bailey	sun sedge	
Cahe2	*hepburnii* Boott = *C. nardina* Fries, in part		
Cahe3	*heteroneura* W. Boott		
Caheb	*brevisquama* F.J. Herm. = *C. atrata* of some authors, NOT L.	black sedge	
Cahec	*chalciolepis* (Holm) F.J. Herm. = *C. chalciolepis* Holm		bronzescale sedge
Cahee	*epapillosa* (Mack.) F.J. Herm. = *C. epapillosa* Mack.		

[16] Suggested common name.

Grasslike Plants (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Cahol	*hoodii* Boott	Hood sedge	
Cahy	*hystricina* Muhl.	bottlebrush sedge	
Cail	*illota* Bailey	sheep sedge	
Cain	*interior* Bailey	inland sedge	
Cakel	*kelloggii* W. Boott	Kellogg sedge	
Cala	*lanuginosa* Michx.	woolly sedge	
Cale	*leporinella* Mack.		
Calu2	*luzulina* Olney		
Calua	*ablata* (Bailey) F.J. Herm. = *C. ablata* Bailey	wingseed sedge	
Came	*media* R. Br.		
Cami3	*microglochin* Wahl.		
Cami4	*microptera* Mack.	smallwing sedge	
Cami5	*misandra R. Br.*		
Cane	*nebraskensis* Dewey	Nebraska sedge	
Canel	*nelsonii* Mack.		
Cane2	*neurophora* Mack.		
Cani	*nigricans* C.A. Mey.	black alpine sedge	
Canol	*norvegica* Retz.		
Cano	*nova* Bailey		
Caob	*obtusata* Lilj.		
Caocl	*occidentalis* Bailey		western sedge
Caor	*oreocharis* Holm		
Capal	*pachystachya* Steud.	Chamisso sedge	
Capa3	*parryana* Dewey		
Capa2	*paupercula* Michx.		
Cape3	*pelocarpa* F.J. Herm.		
Capel	*perglobosa* Mack.	Mt. Baldy sedge[17]	
Cape2	*petasata* Dewey = *C. liddonii* Boott	Liddon sedge	
Caphl	*phaeocephala* Piper	dunhead sedge	
Caph	*physocarpa* Presl = *C. saxatilis* of some authors, NOT L.		
Capo	*podocarpa* R. Br.		
Capr	*praegracilis* W. Boott = *C. marcida* Boott, of some authors, NOT J. F. Gmel.		silver sedge
Caprl	*praticola* Rydb.		
Caps	*pseudoscirpoidea* Rydb.		
Capy	*pyrenaica* Wahl.		
Cara	*raynoldsii* Dewey	Raynolds sedge	
Cari	*richardsonii* R. Br.		
Caro3	*rossii* Boott	Ross sedge	
Caro2	*rostrata* Stokes = *C. inflata* Huds.	beaked sedge	
Caru	*rupestris* Bellardi ex ALL.		
Casal	*saximontana* Mack.		
Casc3	*scirpoidea* Michx.		
Casc2	*scopulorum* Holm		cliff sedge
Cascc	*chimaphila* (Holm) Kukenth. = *C. chimaphila* Holm		
Case2	*serratodens* W. Boott		
Casi	*simulata* Mack.		
Casp	*sprengelii* Dewey		
Catel	*tenera* Dewey		
Cate	*tetanica* Schkuhr		woods sedge
Cato	*tolmiei* Boott	Tolmie sedge	
Catol	*torreyi* Tuckerm.		
Cava	*vallicola* Dewey	Jackson Hole sedge	valley sedge
Cavel	*vernacula* Bailey		alpine blackheade sedge

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[17] Suggested common name.

Grasslike Plants (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Cave	*vesicaria* L. = *C. inflata* Huds.	blister sedge	
Cavi	*viridula* Michx.	green sedge	
Cavu	*vulpinoidea* Michx.	fox sedge	
Caxe	*xerantica* Bailey		
CYPE	***Cyperus***	**flatsedge**	
Cyac	*acuminatus* Torr. + Hook.	taperleaf flatsedge	
Cyar	*aristatus* Rottb. = *C. inflexus* Muhl.	bearded flatsedge	
Cyes	*esculentus* L.	chufa flatseed	yellow nutgrass
Cyfe2	*fendlerianus* Boeckl.	Fendler flatsedge	tuber flatsedge
Cyod	*odoratus* L.	goodseed flatsedge	
Cypr	*pringlei* Britt.	pine flatsedge	
Cyri	*rivularis* Kunth	brook flatsedge	
Cyro	*rotundus* L.	nutgrass flatsedge	nutgrass
Cyru	*rusbyi* Britt.	hillside flatsedge	
Cysc	*schweinitzii* Torr.	Schweinitz flatsedge	
ELEO	***Eleocharis***	**spikesedge**	**spikerush**
Elac	*acicularis* (L.) R. + S.	needle spikesedge	needle spikerush
Elov	*ovata* (Roth) R. + S.	ovoid spikesedge	
Elpa1	*palustris* (L.) R. + S. = *E. macrostachya* Britt.	common spikesedge	
Elpa	*pauciflora* (Lightf.) Link = *Scirpus pauciflora* Lightf.	fewflowered spikesedge	
ERIO3	***Eriophorum***	**cottonsedge**	
Eran3	*angustifolium* Honck. = *E. polystachyon* of some authors, NOT L.	narrowleaf cottonsedge	
Erca7	*callitrix* Cham.		
Erch2	*chamissonis* C.A. Mey.		Chamisso cottonsedge
Ergr1	*gracile* Koch		
Ersc1	*scheuchzeri* Hoppe		
JUNC	***Juncus***	**rush**	
Jual	*albescens* (Lange) Fern. = *j. triglumis* of American authors, NOT L.		
Jual1	*alpinus* Vill.	alpine rush	
Juba	*balticus* Willd.	Baltic rush	wire rush
Jubam	*montanus* Engelm.		
Jubi	*biglumis* L.		
Jubu	*bufonius* L.	toad rush	
Juca	*castaneus* J.E. Sm.		
Juco2	*confusus* Cov.		
Judr	*drummondii* E. Mey.		Drummonds rush
Judrs	*subtriflorus* (E. Mey.) C.L. Hitchc. = *J. subtriflorus* (E. Mey.) Cov.		
Juen	*ensifolius* Wikstr.		swordleaf rush
Jufi	*filiformis* L.		thread rush
Juha	*hallii* Engelm.		Halls rush
Juin	*interior* Wieg.	inland rush	
Julo	*longistylis* Torr.		longstyle rush
Jume	*mertensianus* Bong.		Mertens rush, blackheaded rush
June	*nevadensis* Wats.		
Juneb	*badius* (Suksd.) C.L. Hitchc. = *J. badius* Suksd.		longfruited rush
Junec	*columbianus* (Cov.) St. John = *J. columbianus* Cov.	Columbian rush	

Grasslike Plants (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Juno	*nodosus* L.	jointed rush	
Jupa	*parryi* Engelm.		Parrys rush
Jurel	*regelii* Buch.	Regels rush	
Jusa	*saximontanus* A. Nels. = *J. xiphioides* E. Mey., var. *montanus* Engelm.	RockyMountain rush	
Jusab	*brunnescens* (Rydb.) F.J. Herm. (forma) = *J. brunnescens* Rydb.		
Jute	*tenuis* Willd. = *J. macer S.F. Gray*	poverty rush	
Juted	*dudleyi* (Wieg.) F.J. Herm. = *J. dudleyi* Wieg.		Dudley rush
Juto	*torreyi* Cov.	Torrey rush	bur rush
Jutr	*tracyi* Rydb.		
Juva	*vaseyi* Engelm.		
KOBR	***Kobresia***	**kobresia**	
Komy	*myosuroides* (Vill.) Fiori + Paol. = *K. bellardii* (All.) Degland		
LUZU	***Luzula* = *Juncoides***	**woodrush**	
Lucol	*comosa E. Mey.* = *J. comosum* Sheld. = *L. campestris* of some authors, in part, NOT (L.) DC.	hairy woodrush	
Luin	*intermedia* (Thuil.) Spenner = *L. campestris* of some authors, in part, NOT (L.) DC. = *L. campestris* var. *multiflora* Celak. = *L. multiflora* Lejeune = *L. multiflora* var. *congesta* Koch		
Lupal	*parviflora* (Ehrh.) Desv. = *J. parviflorum* Cov. = *L. piperi* M.E. Jones	millet woodrush	
Luspl	*spicata* (L.) DC. = *J. spicatum* Cov.	spike woodrush	
Luwa	*wahlenbergii* Rupr.	Wahlenberg woodrush	
SCIR	***Scirpus***	**bulrush**	
Scac	*acutus* Muhl. = *S. lacustris* of some authors, in part, NOT L. = *S. lacustris* var. *occidentalis* Wats. = *S. occidentalis* Chase	tule bulrush	tule
Scam	*americanus* Pers.	American bulrush	salty bulrush
Scat	*atrovirens* Willd.	green bulrush	
Scmi	*microcarpus* Presl	panicled bulrush	
Scne	*nevadensis* Wats.	Nevada bulrush	
Scol	*olneyi* Gray	Olney bulrush	
Scpa2	*pallidus* (Britt.) Fern. = *S. atrovirens* var. *pallidus* Britt.		
Scpal	*paludosus* A. Nels.	alkali bulrush	
Scsu	*subterminalis* Torr.		
Scva	*validus* Vahl	softstem bulrush	

Forbs

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
ABRO	***Abronia* = *Tripterocalyx***	**sandverbena**	
Aban	*angustifolia* Greene		purple sandverbena
Abel	*elliptica* A. Nels.	pink sandverbena	
	= *A. fragrans* var. *elliptica* M. E. Jones		
Abfr	*fragrans* Hook.	snowball sandverbena	
Abmi	*micranthus* Torr.	sandpuffs	
Abvi	*villosa* Wats.	desert sandverbena	
ACHI	***Achillea***	**yarrow**	**milfoil**
Acla	*lanulosa* Nutt.	western yarrow	
	= *A. millefolium* var. *lanulosa* Piper		
Aclaa	*alpicola* Rydb.	subalpine yarrow	
	= *A. alpicola* Rydb.		
	= *A. subalpina* Greene		
Acmi	*millefolium* L.	common yarrow	
ACON	***Aconitum***	**monkshood**	
Acco2	*columbianum* Nutt.	Columbia monkshood	aconite, wolfbane
	= *A. lutescens* A. Nels.		
Accob	*bakeri* (Greene) Harrington	Baker monkshood	
Acte	*tenue* Rydb.	Black Hills monkshood	
ACTA	***Actaea***	**baneberry**	
Acru	*rubra* (Ait.) Willd.	red baneberry	
	= *A. arguta* Nutt.	western baneberry	
	= *A. rubra* ssp. *arguta* Hulten	green western baneberry	
	= *A. viridiflora* Greene		
	= *A. rubra f. neglecta* (an occas. white-fruited form)		
ADIA	***Adiantum***	**maidenhair**	**maidenhair fern**
ADOX	***Adoxa***	**muskroot**	
Admo	*moschatellina* L.	muskroot	
AGAS	***Agastache***	**gianthyssop**	**horsemint**
Agca	*cana* (Hook.) Woot. + Standl.	mosquitoplant	
Agfo	*foeniculum* (Pursh) Kuntze	fennel gianthyssop	
	= *A. anethiodora* Britt.		
Agur	*urticifolia* Kuntze	nettleleaf gianthyssop	nettleleaf horsemint
AGOS	***Agoseris* = *Troximon***	**agoseris**	**mountain-dandelion**
Agau	*aurantiaca* (Hook.) Greene	orange agoseris	
	= *A. gracilens* Kuntze		
	= *A. greenei* Rydb.		
	= *A. graminifolia* Greene		
Agaup	*purpurea* (Gray) Cronq.		
	= *A. purpurea* Greene		
	= *A. arizonica* Greene		
Agel	*elata* (Nutt.) Greene		
Aggl	*glauca* (Pursh) Raf.	pale agoseris	
	= *A. attenuata* Rydb.		
	= *A. dasycephala* T. + G.		
	= *A. laciniata* Greene		
	= *A. leontodon* Rydb.		
	= *A. maculata* Rydb.		
	= *A. roseata* Rydb.		
	= *A. turbinata* Rydb.		
Aggla	*agrestis* (Osterh.) Q. Jones		
	= *A. agrestis* Osterh.		
	= *A. altissima* Rydb.		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Aggld	*dasycephala* (T. + G.) Jeps.		
	= *A. aspera* Rydb.		
	= *A. pumila* Rydb.		
	= *A. scorzoneraefolia* Greene		
	= *A. villosa* Rydb.		
Aggll	*laciniata* (D.C. Eat.) Smiley		
	= *A. parviflora* D. Dietr.		
	= *A. rosea* D. Dietr.		
Agglm	*monticola* (Greene) Q. Jones		
	= *A. monticola* Greene		
Aggr2	*grandiflora* (Nutt.) Greene		
Aghe	*heterophylla* (Nutt.) Greene	annual agoseris	
AGRI	***Agrimonia***	**agrimony**	
Aggr3	*gryposepala* Wallr.		
Agst	*striata* Michx.	roadside agrimony	
ALET	***Aletes***	**aletes**	
Alac1	*acaulis* (Torr.) C. + R.		
ALIS	***Alisma***	**waterplantain**	
ALLE	***Allenrolfea***	**pickleweed**	**iodinebush**
Aloc	*occidentalis* (Wats.) Kuntze		
ALLI1	***Allionia* = *Wedelia* = *Wedeliella***	**allionia**	
Alin	*incarnata* L.	trailing allionia	umbrellawort, wild four-o'clock
ALLI	***Allium***	**onion**	
Alac	*acuminatum* Hook.	tapertip onion	
Albr1	*brandegei* Wats.	Brandegee onion	
Albr	*brevistylum* Wats.	shortstyle onion	
Alca	*canadense* L.	Canada garlic	
	= *A. mutabile* Michx.		
Alce1	*cepa* L.	garden onion	
Alce	*cernuum* Roth	nodding onion	
	= *A. neomexicanum* Rydb.		
	= *A. recurvatum* Rydb.		
Aldr	*drummondii* Regel	Drummond onion	
	= *A. nuttallii* Wats.		
Alge1	*geyeri* Wats.	Geyer onion	
Alget	*tenerum* M. E. Jones		
	= *A. rubrum* Osterh.		
Alsc	*schoenoprasum* L.	chive	
Alscl	*laurentianum* Fern.		
Alscs	*sibiricum* Hartm.	Siberian chive	
	= *A. sibiricum* L.		
Alte1	*textile* Nels. + Macbr.	textile onion	
	= *A. reticulatum* Nutt.		
AMAR	***Amaranthus***	**amaranth**	**pigweed**
Amal1	*albus* L.		
	= *A. graecizans* of some manuals, in part.		
Amgr	*graecizans* L.	tumbleweed amaranth	
	= *A. blitoides* Wats.		
Amhy	*hybridus* L.	slim amaranth	
Ampa1	*palmeri* Wats.		carelessweed amaranth
Ampo1	*powellii* Wats.	Powell amaranth	
Amre	*retroflexus* L.	redroot amaranth	
Amsp	*spinosus* L.	spiny amaranth	
AMBR	***Ambrosia***	**ragweed**	
Amar	*artemisiifolia* L.	common ragweed	

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Amare	*elatior* (L.) Desc.		
	= *A. elatior* L.		
Amps	*psilostachya* DC.	western ragweed	
	= *A. coronopifolia* T. + G.		
Amtr	*trifida* L.	giant ragweed	richweed
Amtrt	*texana* Scheele		
	= *A. aptera* DC.		
AMSI	***Amsinckia***	**fiddleneck**	
Amre1	*retrorsa* Suksd.		
	= *A. rugosa* Rydb.		
AMSO	***Amsonia***	**amsonia**	
Amci	*ciliata* Walt.		
Amcit	*texana* (Gray) Coult.		
	= *A. texana* Heller		
Amjo	*jonesii* Woods.		
Ampa2	*palmeri* Gray	Palmer amsonia	
ANAP	***Anaphalis***	**pearleverlasting**	
Anma	*margaritacea* (L.) B. + H.	common pearleverlasting	
	= *Gnaphalium margaritaceum* L.		
Anmas	*subalpina* Gray	western common pearleverlasting	western pearleverlasting
Anmao	*occidentalis* Greene	western common pearleverlasting	
ANDR2	***Androsace***	**rockjasmine**	
Anca1	*carinata* Torr.		
Anfi	*filiformis* Retz.		
Anoc	*occidentalis* Pursh	western rockjasmine	
Anse	*septentrionalis* L.		
Ansep	*puberulenta* (Rydb.) Knuth		
	= *A. puberulenta* Rydb.		
Anses	*subumbellata* A. Nels.		
	= *Androsace subumbellata* Small		
ANEM	***Anemone***	**anemone**	**windflower**
Anca	*canadensis* L.	meadow anemone	
Anca2	*caroliniana* Walt.	Carolina anemone	
Ancy	*cylindrica* Gray	candle anemone	
Anpa	*patens* L.	American pasqueflower	pasqueflower
	= *A. ludoviciana* Nutt.		
	= *Pulsatilla ludoviciana* Heller		
	= *P. patens* Miller		
Anmu	*multifida* Poir.		
Anmum	*multifida*		
	= *A. hudsoniana* Richards.	Hudsonian anemone	
Anmug	*globosa* T. + G.	Pacific anemone	
	= *A. globosa* Pritz.		
Anna	*narcissiflora* L.	narcissus anemone	
	= *A. zephyra* A. Nels.		
Antu	*tuberosa* Rydb.	tuber anemone	
ANGE	***Angelica***	**angelica anemone**	
Anam	*ampla* A. Nels.		
Angr	*grayi* C. + R.	Grays anemone	
Anpi	*pinnata* Wats.	small-leaf angelica	
ANOD	***Anoda***	**anoda**	
ANTE	***Antennaria***	**pussytoes**	
Anal	*alpina* (L.) Gaertn.	alpine pussytoes	
Anan	*anaphaloides* Rydb.		

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Anca3	*campestris* Rydb.		
Ancol	*corymbosa* E. Nels.	plains pussytoes[18]	
	= *A. nardina* Greene		
Andi	*dimorpha* (Nutt.) T. + G.		
Anlul	*luzuloides* T. + G.	rush pussytoes	
Anne	*neglecta* Greene	field pussytoes	
Anpal	*parvifolia* Nutt.		
	= *A. aprica* Greene		
Anpl	*plantaginifolia* (L.) Hook.	plantainleaf pussytoes	
Anpu	*pulcherrima* (Hook.) Greene	showy pussytoes	
Anra	*racemosa* Hook.	raceme pussytoes	
Anro	*rosea* (D.C. Eat.) Greene	rose pussytoes	
	= *A. arida* E. Nels.		
	= *A. bracteosa* Rydb.		
	= *A. microphylla* Rydb.		
	= *A. oxyphylla* Greene		
Anrol	*rosulata* Rydb.		
Anum	*umbrinella* Rydb.		
	= *A. mucronata* E. Nels.		
	= *A. sedioides* Greene		
	= *A. viscidula* Rydb.		
ANTH2	***Anthemis***	**camomile**	
Anco	*cotula* L.	mayweed camomile	camomile, maywee dogfennel
ANTH1	***Anthericum* L.**	**anthericum**	
Anto	*torreyi* Baker	Torrey anthericum	craglily
APOC	***Apocynum***	**dogbane (Indian-hemp)**	
Apan	*androsaemifolium* L.	spreading dogbane	
Apana	*androsaemifolium*		
	= *A. scopulorum* Rydb.	cliff dogbane	
Apang	*glaucum Macoun*		shiny dogbane
	= *A. ambigens* Greene		
Apanp	*pumilum*	low dogbane	
	= *A. pumilum* Greene		
Apca	*cannabinum* L.	hemp dogbane	
APOD	***Apodanthera***		**gourd, melon-loco melon-gourd**
Apun	*undulata* Gray		
AQUI	***Aquilegia***	**columbine**	
Aqbr	*brevistyla* Hook.	Yukon columbine	
Aqca	*caerulea* James	Colorado columbine	
Aqcap	*pinetorum* (Tidest.) Pays. (ssp.)	pine columbine	
	= *A. pinetorum* Tidest.		
Aqcad	*daileyae* Eastw.		
Aqcao	*ochroleuca* Hook.		
	= var. *albiflora* Gray		
Aqcal	*canadensis* L.	American columbine	
Aqch	*chrysantha* Gray	golden columbine	
Aqel	*elegantula* Greene	westernred columbine	
Aqfl	*flavescens* Wats.	yellow columbine	
Aqjo	*jonesii* Parry	Jones columbine	
Aqsa	*saximontana* Rydb.	RockyMountain columbine	
ARAB	***Arabis***	**rockcress**	
Arbr	*breweri* Wats.	Brewer rockcress	

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[18] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
Arco	*cobrensis* M. E. Jones = *A. canescens* Nutt.	silver rockcress	
Arcr	*crandallii* Robins.	Crandall rockcress[19]	
Ardi2	*divaricarpa* A. Nels.		
Ardr1	*drummondii* Gray = *A. connexa* Greene = *A. oxyphylla* Greene	Drummond rockcress	
Arfe3	*fendleri* (Wats.) Greene	Fendler rockcress	
Arfes	*spatifolia* (Rydb.) Rollins		
Argl3	*glabra* (L.) Bernh.	towermustard rockcress	
Arhi	*hirsuta* (L.) Scop.		
Arhip	*pycnocarpa* (Hopkins) Rollins = *A. ovata* of some manuals		
Arho2	*holboellii* Hornem. = *A. exilis* A. Nels.	Hoboel rockcress	
Arhor	*retrofracta* (Grah.) Rydb. = *A. rhodantha* Greene	rose rockcress	
Arli1	*lignifera* A. Nels.		
Arly	*lyallii* Wats.	Lyall rockcress	
Armi2	*microphylla* Nutt.	littleleaf rockcress	
Arnu	*nuttallii* Robins. = *A. spathulata* Nutt.	Nuttall rockcress	
Arpe2	*perennans* Wats. = *A. recondita* Greene		
Arsp2	*sparsiflora* Nutt.		
ARAL	***Aralia***	**aralia**	
Arra	*racemosa* L.	American spikenard	aralia spikenard
ARCT3	***Arctium***	**burdock**	
Armi1	*minus* (Hill) Bernh.	smaller burdock	burdock
ARCT2	***Arctomecon***	**bearpoppy**	**desertpoppy**
AREN	***Arenaria***	**sandwort**	
Arac	*aculeata* Wats.	prickly sandwort	
Arca	*capillaris* Poir.		
Arco1	*congesta* Nutt.	ballhead sandwort	
Arcol	*lithophila* Rydb. = *A. lithophila* Rydb.		
Arfe2	*fendleri* Gray	Fendler sandwort	
Arfed	*diffusa* Porter		
Arho1	*hookeri* Nutt. = *A. pinetorum* A. Nels.	Hooker sandwort	
Arla4	*lanuginosa* (Michx.) Rohrb.		
Arlas	*saxosa* (Gray) Maguire (ssp.) = *A. saxosa* Gray = *A. confusa* Rydb.		
Arla2	*lateriflora* L. = *Moehringia lateriflora* Fenzl.	bluntleaf sandwort	
Arma1	*macrophylla* Hook.	trailing sandwort	
Arob	*obtusiloba* (Rydb.) Fern. = *A. sajanensis* of some authors		
Arro	*rossii* R. Br.		
Arru	*rubella* (Wahl.) J.E. Sm. = *A. aequicaulis* A. Nels. = *A. propinqua* Richards. = *A. verna* of some manuals		

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[19] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
ARGE	***Argemone***	**pricklepoppy**	**chicalote**
Arhi1	*hispida* Gray	hedgehog pricklepoppy	
	= *A. platyceras* Link + Otto		
	= *A. platyceras* var. *hispida* Prain		
Arpo	*polyanthemos* (Fedde) G.B. Ownbey		
	= *A. intermedia* of some authors		
ARIS1	***Aristolochia***	**Dutchmanspipe**	
Arwa	*watsonii* Woot. + Standl.	Watson Dutchmanspipe	Indianroot
ARNI	***Arnica***	**arnica**	
Arco2	*cordifolia* Hook.	heartleaf arnica	
Arch	*chamissonis* Less.	leafy arnica	
	= *A. foliosa* Nutt.		
	= *A. incana* Greene		
Arfu	*fulgens* Pursh	orange arnica	
	= *A. monocephala* Rydb.		
	= *A. pedunculata* Rydb.		
Arla	*latifolia* Bong.	broadleaf arnica	
	= *A. ventorum* Greene		
Arlo2	*longifolia* D.C. Eat.	longleaf arnica	
Armo	*mollis* Hook.	hairy arnica	
	= *A. silvatica* Greene		
	= *A. subplumosa* Greene		
Arpa2	*parryi* Gray	rayless arnica	
Arry	*rydbergii* Greene	Rydberg arnica	
ARTE	***Artemisia* See also under TREES AND SHRUBS**		
Arab2	*abrotanum* L.[20]	oldman wormwood	
Aran	*annua* L.	sweet wormwood	
Arbi	*biennis* Willd.	biennial wormwood	
Arca4	*campestris* L.	sagewort wormwood	
	= *A. borealis* Pall.		
	= *A. camporum* Rydb.		
	= *A. caudata* Michx.		
	= *A. forwoodii* Wats.		
	= *A. pacifica* Nutt.		
Ardr3	*dracunculus* L.	falsetarragon	
	= *A. aromatica* A. Nels.		
	= *A. dracunculoides* Pursh.		
Arfr2	*franserioides* Greene	ragweed sagebrush	
Arlu	*ludoviciana* Nutt.	Louisiana sagebrush	
Arlui	*incompta* (Nutt.) Cronq.		
	= *A. incompta* Nutt.		
Arlul	*ludoviciana* (Nutt.) Cronq.		
	= *A. gnaphalodes* Nutt.		
Arlum	*mexicana* (Willd.) Keck (ssp.)		
	= *A. mexicana* Willd.		
Arno1	*norvegica* Fries		
	= *A. arctica* Less.		
Arnos	*saxatilis* (Bess.) Jeps.		
ASCL	***Asclepias***	**milkweed**	
Asas	*asperula* (Dcne.) Woods.		
Asasc	*capricornu* (Woods.) Woods. (ssp.)		
	= *A. capricornu* Woods.		
Asasd	*decumbens* (Nutt.) Shinners		
	= *A. decumbens* K. Schum.		
	= *Asclepiodora decumbens* Gray		
Aser	*erosa* Torr.	desert milkweed	

[20] Subshrub, woody at base only.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
Asha1	*hallii* Gray	Halls milkweed	
Asin3	*incarnta* L.	swamp milkweed	
Asin1	*involucrata* Engelm.	dwarf milkweed	
Asov	*ovalifolia* Dcne.		
Aspu1	*pumila* (Gray) Vail	plains milkweed	
Assp1	*speciosa* Torr.	showy milkweed	
Asst1	*stenophylla* Gray		
Assu2	*subulata* Dcne.	skeleton milkweed	
Assu1	*subverticillata* (Gray) Vail		horsetail milkweed
	= *A. galioides* of some authors		
Astu	*tuberosa* L.	butterfly milkweed	pleurisy-root
Astui	*interior* Woods. (spp.)		
Asve1	*verticillata* L.	whorled milkweed	
Asvi1	*viridiflora* Raf.		
	= *Acerates viridiflora* Eat.		
ASPE	***Asperugo***	**catchweed or madwort**	
Aspr	*procumbens* L.		
ASPL	***Asplenium***	**spleenwort**	
Asse	*septentrionale* (L.) Hoffm.	grassleaf speenwort	
ASTE	***Aster* (see Machaeranthera, Leucelene)**	**aster**	
Asal3	*alpigenus* (T. + G.) Gray		
	= *A. haydenii* Porter		
	= *Oreastrum alpigenum* Greene		
Asca2	*campestris* Nutt.		
Asch	*chilensis* Nees		
	= *A. adscendens* Lindl.		
	= *A. nelsonii* Greene		
Asea	*eatonii* (Gray) Howell	Eatons aster	
Asen	*engelmannii* (D.C.Eat.) Gray	Engelmann aster	
Aser1	*ericoides* L.	heath aster	
	= *A. multiflorus* Ait.		
Asfa	*falcatus* Lindl.		
	= *A. commutatus* Gray		
	= *A. crassulus* Rydb.		
Asfo	*foliaceus* Lindl.	leafybract aster	
Asfoa	*apricus* Gray	alpine leafybract aster	
	= *A. apricus* Rydb.		
Asfoc	*canbyi* Gray	Canby leafybract aster	
	= *A. canbyi* Rydb.		
	= *A. burkei* Howell		
	= *A. foliaceus* var. *burkei* Gray		
Asfop	*parryi* (D.C. Eat.) Gray	Parry leafybract aster	
	= *A. ciliomarginatus* Rydb.		
	= *A. foliaceus* var. *frondeus* Gray		
	= *A. frondeus* Greene		
Asgl	*glaucodes* Blake		
	= *A. glaucus* T. + G.		
Ashe	*hesperius* Gray	Siskiyou aster	
Asin2	*integrifolius* Nutt.	thickstem aster	
	= *A. amplexifolius* Rydb.		
Asla	*laevis* L.		
Aslag	*geyeri* Gray	smooth aster	
	= *A. geyeri* Howell		
Asob	*oblongifolius* Nutt.	aromatic aster	

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Asoc	*occidentalis* (Nutt.) T. + G. = *A. fremontii* Gray	western aster Fremont aster	
Aspe	*perelegans* Nels. + Macbr.	Nuttall aster	
Aspo	*porteri* Gray	Porters aster	
Assc	*scopulorum* Gray = *Ionactis alpina* Greene	crag aster	
Assp2	*spinosus* Benth.	devilweed aster	spiny aster, devilweed
ASTR	***Astragalus***	**milkvetch, loco, poisonvetch**	
Asab1	*aboriginum* Richards. = *Atelophragma aboriginum* Rydb.	Indian milkvetch	
Asad	*adsurgens* Pall. = *A. striatus* Nutt.		
Asag	*agrestis* G. Don = *A. goniatus* T. + G.	purple milkvetch	
Asal1	*allochrous* Gray	halfmoon loco	
Asal2	*alpinus* L. = *Tium alpinum* Rydb. = *Atelophragma alpinum* Rydb.	alpine milkvetch	
Asam	*americanus* (Hook.) M.E. Jones = *Phaca americana* Rydb.		
Asar	*arizonicus* Gray	Arizona loco	
Asbe	*beckwithii* T. + G.	Beckwith milkvetch	
Asbi3	*bisulcatus* (Hook.) Gray	twogrooved loco	
Asbih	*haydenianus* (Gray) Barneby	Hayden poisonvetch	
Asca4	*calycosus* Wats. = *Hamosa calycosa* Rydb.		
Asca1	*canadensis* L.	Canada milkvetch	
Ascab	*brevidens* (Gand.) Barneby = *A. brevidens* Rydb.		
Ascam	*mortonii* (Nutt.) Wats.		Morton loco
Asce	*ceramicus* Sheld. = *A. pictus* Gray = *Phaca picta* Gray		
Asci1	*cibarius* Sheld. = *Xylophacos cibarius* Rydb.		
Asco	*convallarius* Greene = *A. campestris* Gray = *A. junceus* Gray = *A. diversifolius* var. *junceus* M.E. Jones	timber poison milkvetch	
Ascr	*crassicarpus* Nutt. = *A. succulentus* Richards.	groundplum milkvetch	
Asdi	*diversifolius* Gray = *A. campestris* var. *diversifolius* Macbr. = *A. convallarius* var. *diversifolius* Tidest.		
Asdr	*drummondii* Hook. = *Tium drummondii* Rydb.	Drummond milkvetch	
Asfl	*flexuosus* (Hook.) G. Don = *Homalobus flexuosus* Rydb.	flexile milkvetch	flexible milkvetch
Asgi	*gilviflorus* Sheld.		
Asgr	*gracilis* Nutt.		
Asha	*hallii* Gray		
Asio	*iodopetalus* (Rydb.) Barneby		
Aske	*kentrophyta* Gray		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Askee	*elatus* Wats.	thistle milkvetch	
	= *A. impensus* Woot. + Standl.		
	= *A. viridis* Sheld., in part		
Asle3	*lentiginosus* Hook.	specklepod loco	
Aslea	*araneosus* (Sheld.) Barneby	dryplains milkvetch	
	= *A. araneosus* Sheld.		
Asled	*diphysus* (Gray) Jones	blue loco	rattlepod
Aslo	*lonchocarpus* Torr.		
Asmi	*miser* Hook.		
Asmid	*decumbens* (Nutt.) Cronq.	decumbent milkvetch	
	= *Homalobus decumbens* Nutt.		
Asmio	*oblongifolius* (Rydb.) Cronq.		
	= *Homalobus decurrens* Rydb.		
	= *A. decumbens* var. *oblongifolius* Cronq.		
	= *A. miser* var. *decurrens* Cronq.		
Asmo	*mollissimus* Torr.	woolly loco	
Asmob	*bigelovii* (Gray) Barneby	Bigelow milkvetch	
	= *A. bigelovii* Gray		
Asno	*nothoxys* Gray	sheep loco	
Asnu	*nuttallianus* A. DC.	Nuttall loco	
Asoo	*oophorus* Wats.		
	= *A. artipes* Gray		
	= *Phaca artipes* Rydb.		
Aspa3	*parryi* Gray		
Aspa	*pattersonii* Brand.	Patterson loco	
	= *Rydbergiella pattersonii* Fedde + Sydow		
Aspel	*pectinatus* G. Don	narrowleaf poisonvetch	
Aspu	*purshii* Hook.	Pursh loco	
	= *Xylophacos purshii* Rydb.		
Aspug	*glareosus* (Dougl.) Barneby		
	= *Xylophacos glareosus* Rydb.		
Asra	*racemosus* Pursh		
Asscl	*scopulorum* Porter	RockyMountain milkvetch	
Assel	*sericoleucus* Gray		
Assh	*shortianus* Nutt.		
Assp3	*spatulatus* Sheld.	tufted milkvetch	
	= *A. caespitosus* Gray		
	= *Homalobus caespitosus* Nutt.		
Assu3	*subcinereus* Gray		
	= *Phaca subcinerea* Rydb.		
Astel	*tenellus* Pursh	looseflower milkvetch	
Aste	*tephrodes* Gray	towline loco	
Asteb	*brachylobus* (Gray) Barneby		
	= *A. shortianus* var. *brachylobusa*	Gray	
Asth	*thurberi* Gray	Thurber loco	
Astr	*tridactylicus* Gray		
	= *Orophaca tridactylica* Rydb.		
Asut	*utahensis* (Torr.) T. + G.	Utah loco	
	= *Xylophacos utahensis* Rydb.		
Asve	*vexilliflexus* Sheld.		
	= *A. pauciflorus* Hook.		
Aswi	*wingatanus* Wats.		
	= *Homalobus wingatanus* Rydb.		
Aswo	*wootonii* Sheld.	Wooton loco	
ATHY	***Athyrium* Roth**		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Atal	*alpestre* (Hoppe) Moore = *A. americanum* Maxon		
Atan	*angustum* (Willd.) Presl		
Atfi	*filix-femina* (L.) Roth = *Asplenium filix-femina* Bernh.	ladyfern	
BAER	***Baeria***	**goldfields**	
Bach	*chrysostoma* Fisch. + Mey.	branchy goldfields	goldfields
BAHI	***Bahia* = *Amauriopsis* = *Picradeniopsis***	**bahia**	
Badi	*dissecta* (Gray) Britt.	ragleaf bahia	
Bane	*neomexicana* Gray		New-Mexican bahi
Baop	*oppositifolia* (Nutt.) DC. = *Picradeniopsis oppositifolia* Rydb.	plains bahia	
Bawo	*woodhousei* Gray		Woodhouse bahia
BAIL	***Baileya***	**baileya**	**desertmarigold**
Bamu	*multiradiata* Harv. + Gray	desert baileya	
BALS	***Balsamorhiza***	**balsamroot**	
Baho	*hookeri* Nutt.	Hooker balsamroot[21]	
Bain	*incana* Nutt.	hoary balsamroot	
Basa2	*sagittata* (Pursh) Nutt.	arrowleaf balsamroot	
BARB	***Barbarea* = *Campe***	**wintercress**	
Baor	*orthoceras* Ledeb. = *Campe orthoceras* Heller = *B. americana* Rydb.	erectpod wintercress	wintercress
Bavu	*vulgaris* R. Br.	bitter wintercress	
BASS	***Bassia***	**bassia**	
Bahi	*hirsuta* (L.) Asch.	hairy bassia	
Bahy	*hyssopifolia* (Pall.) Kuntze = *Echinopsilon hyssopifolius* Moq. = *Salsola hyssopifolia* Pall.	fivehook bassia	
BERG	***Bergia***		
Bete	*texana* (Hook.) Seub.	Texas bergia	
BERU	***Berula***		
Beer	*erecta* (Huds.) Cov.	stalky berula	
BESS	***Besseya***	**kittentails**	
Beal	*alpina* (Gray) Rydb.	alpine kittentails	
Belp	*plantaginea* (James) Rydb.	plantainleaf kittentails	
Beri	*ritteriana* (Eastw.) Rydb. = *Synthyris ritteriana* var. *obtusa* A. Nels.	Ritter kittentails	
Beru	*rubra* (Dougl.) Rydb.	red kittentails	
Bewy	*wyomingensis* (A. Nels.) Rydb. = *B. cinerea* (Raf.) Pennell		
BIDE	***Bidens***	**beggarticks**	
Bibi	*bigelovii* Gray		water beggarticks
Bice	*cernua* L.	nodding beggarticks	
Bihe	*heterosperma* Gray		bur-marigold
Bila	*laevis* (L.) B.S.P.	smooth beggarticks	
Bile	*leptocephala* Sherff		pitchfork beggarticks
Bite	*tenuisecta* Gray		sticktight beggarticks

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[21] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
BOER	***Boerhaavia***	**spiderling**	
Boco1	*coccinea* Mill.	scarlet spiderling	trailing spiderling
Boco2	*coulteri* (Hook. f.) Wats.		Coulter spiderling
Boer1	*erecta* L.	erect spiderling	
BOTR	***Botrychium***	**grapefern**	
Bosi1	*simplex* E. Hitchc.	little grapefern[22]	
BRAS	***Brassica***	**mustard**	
Brca4	*campestris* L.	bird rape	
Brhi	*hirta* Moench	white mustard	
Brju	*juncea* (L.) Coss.	India mustard	
Brka	*kaber* (DC.) Wheeler = *B. arvensis* Rabenh.	charlock	
Brni	*nigra* (L.) Koch	black mustard	
BROD	***Brodiaea***		
Brpu2	*pulchella* (Salisb.) Greene = *Dichelostemma pulchella* Heller	purplehead brodiaea	
BUPL	***Bupleurum***	**thorowax**	
Buam	*americanum* C. + R.	American thorowax[23]	
Buro	*rotundifolium* L.	roundleaf thorowax	
CALA2	***Calandrinia***	**rockpurslane**	
Caam	*ambigua* (Wats.) Howell	alkali rockpurslane	
Caci	*ciliata* (R. + P.) DC.		
Cacim	*menziesii* (Hook.) Macbr. = *C. caulescens* var. *menziesii* Gray	redmaids rockpurslane	
CALL1	***Callirhoe***	**poppymallow**	
Cale3	*leiocarpa* Martin = *C. pedata* Gray	tall poppymallow	
CALO	***Calochortus***	**mariposa**	**mariposalily, sego lily, mariposatulip**
Cagu	*gunnisonii* Wats.	Gunnison mariposa	
Cake	*Kennedyi* Porter	desert mariposa	
Canu	*nuttallii* T. + G.	segolily mariposa	segolily
Canua	*aureus* (Wats.) Ownbey	golden segolily mariposa	golden segolily
CALT	***Caltha***	**marshmarigold**	
Cale1	*leptosepala* DC. = *C. rotundifolia* Greene	elkslip marshmarigold	marshmarigold, elkslip
CALY	***Calypso***	**calypso**	
Cabu1	*bulbosa* (L.) Oakes = *Cytherea bulbosa* House = *Cytherea occidentalis* Heller	calypso	
CAME	***Camelina***	**falseflax**	
Cami2	*microcarpa* Andrz.	littlepod falseflax	
Casa	*sativa* (L.) Crantz	bigseed falseflax	
CAMP	***Campanula***	**bellflower**	
Capa	*parryi* Gray	Parry bellflower	
Caro1	*rotundifolia* L. = *C. petiolata* A. DC. = *C. rotundifolia* var. *petiolata* Henry	bluebell	harebell

[22] Suggested common name.
[23] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
CAPS	***Capsella***	**shepherdspurse**	
Cabu	*bursa-pastoris* (L.) Medic.	shepherdspurse	
CARD	***Cardamine***	**bittercress**	
Caco2	*cordifolia* Gray	heartleaf bittercress	
	= *C. infausta* Greene		
Cahi	*hirsuta* L.	Pennsylvania bittercress	
CARD1	***Cardaria***	**whitetop**	
Cadr	*draba* (L.) Desv.	whitetop pepperweed	hoary cress
	= *Lepidium draba* L.		
Capu	*pubescens* (Meyer) Jarm.	hairy whitetop	
Capue	*elongata* Rollins		
CARD2	***Carduus***	**bristlethistle**	**plumeless thistle**
CARU	***Carum***		
Caca1	*carvi* L.	caraway	
CASS	***Cassia*** **See also under TREES AND SHRUBS**	**senna**	**partridgepea**
Caco1	*covesii* Gray	hairy senna	
Cafa	*fasciculata* Michx.	showy partridgepea	
	= *Chamaecrista fasciculata* Greene		
Cale2	*leptocarpa* Benth.	slimpod senna	
Cawr	*wrightii* Gray	Wrights partridgepea	partridgepea
	= *Chamaecrista wrightii* Woot. + Standl.		
CAST	***Castilleja***	**paintedcup**	**paintbrush**
Caan	*angustifolia* (Nutt.) G. Don	northwestern paintedcup	
Caap1	*applegatei* Fern.		
	= *C. pinetorum* Fern.		
Cach	*chromosa* A. Nels.		
	= *C. angustifolia* of some authors		
	= *C. collina* A. Nels.		
Caco3	*coccinea* (L.) Spreng.	Indian paintbrush	
Cacu	*cusickii* Greenm.	scarlet paintedcup	
	= *C. lutea* Heller		
Cafl	*flava* Wats.	yellow paintedcup	yellow paintbrush
	= *C. brachyantha* Rydb.		
Cagr	*gracillima* Rydb.		
Caha1	*haydenii* (Gray) Cockll.	Hayden paintedcup[24]	
Cain2	*integra* Gray	wholeleaf paintedcup	wholeleaf paintbrush
Cali1	*linariaefolia* Benth.	Wyoming paintedcup	Wyoming paintbr
Cali3	*lineata* Greene		
Cami	*miniata* Hook.	scarlet paintedcup	scarlet paintbrush
	= *C. confusa* Greene		
	= *C. linearis* Rydb.		
Caoc	*occidentalis* Torr.	western paintedcup	
Capa4	*pallescens* (Gray) Greenm.	pale paintedcup	
Carh	*rhexifolia* Rydb.	splitleaf paintedcup	splitleaf paintbrush
Case	*septentrionalis* Lindl.	sulfur paintedcup	sulphur paintbrus
	= *C. sulphurea* Rydb.		
	= *C. luteovirens* Rydb.		
Case1	*sessiliflora* Pursh	downy paintedcup	
CAUC	***Caucalis***	**falsecarrot**	
Cami1	*microcarpa* H. + A.		

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[24] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
CENT1	***Centaurea***	**centaurea, star-thistle**	
Ceam	*americana* Nutt.	basketflower centaurea	basketflower
Ceca	*calcitrapa* L.		star-thistle
Cecy	*cyanus* L.	cornflower	bachelor's button
Ceme	*melitensis* L.	Malta centaurea	Malta star-thistle
Cere1	*repens* L.	Russian centaurea	Russian knapweed
	= *C. picris* Pall.		
Ceso	*solstitialis* L.	yellow centaurea	
CENT2	***Centaurium***	**centaurim**	**canchalagua**
CERA	***Cerastium***	**cerastium**	**mouse-ear chickweed**
Ceal	*alpinum* L.	alpine cerastium	
Cear	*arvense* L.	starry cerastium	starry mouse-ear
	= *C. campestre* Greene		
	= *C. occidentale* Greene		
	= *C. scopulorum* Greene		
	= *C. strictum* L.		
Cebe2	*beeringianum* C. + S.	Bering cerastium	alpine mouse-ear
	= *C. pulchellum* Rydb.		
Cebr1	*brachypodum* (Engelm.) Robins.		
	= *C. nutans* var. *brachypodum* Gray		
Cenu	*nutans* Raf.		
Cest	*strictum* L.	common cerastium	
CHAE	***Chaenactis***	**chaenactis**	**falseyarrow**
Chal1	*alpina* (Gray) M.E. Jones		
Chdo	*douglasii* (Hook.) H. + A.	Douglas chaenactis	Douglas falseyarrow
Chdoa	*achilleaefolia* (H. + A.) A. Nels.		dryland falseyarrow
	= *C. achilleaefolia* H. + A.		
Chst	*stevioides* H. + A.		
CHAM1	***Chamaerhodos***		
Chnu	*nuttallii* (T. + G.) Pickering		
	= *C. erecta* (L.) Bunge		
CHAM2	***Chamaesaracha***		
Chco1	*conioides* (Moric.) Britt.		
Chco	*coronopus* (Dunal) Gray		
CHEI	***Cheilanthes***	**lipfern**	
Chfe1	*feei* Moore	Fee lipfern	
Chfe	*fendleri* Hook.	Fendler lipfern	
CHEN	***Chenopodium* = *Blitum***	**goosefoot**	**pigweed**
Chal	*album* L.	lambsquarters goosefoot	
Cham	*ambrosioides* L.	wormseed goosefoot	
Chat	*atrovirens* Rydb.		
Chbo	*botrys* L.	Jerusalemoak goosefoot	
Chca	*capitatum* (L.) Asch.	blite goosefoot	strawberry-blite goosefoot
	= *Blitum capitatum* L.		
Chch	*chenopodioides* (L.) Aellen		
	= *C. humile* of some authors		
Chfr	*fremontii* Wats.	Fremont goosefoot	
Chgi	*gigantospermum* Aellen		
	= *C. hybridum* var. *gigantospermum* (Aellen) Rouleau		
	= *C. hybridum* L.		
Chgl	*glaucum* L.	oakleaf goosefoot	
Chgls	*salinum* (Standl.) Boiv.		
	= *C. salinum* Standl.		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Chin	*incisum* Poir.	ragleaf goosefoot	
	= *C. graveolens* Willd.		
Chle	*leptophyllum* (Moq.) Wats.	slimleaf goosefoot	
Chleo	*oblongifolium* Wats.		
	= *C. pratericola* Rydb.		
Chmu	*murale* L.	nettleleaf goosefoot	
Chru	*rubrum* L.	red goosefoot	
CHIM	***Chimaphila***	**pipsissewa**	
Chum	*umbellata* (L.) Nutt.	common pipsissewa	
Chumo	*occidentalis* Rydb.	western pipsissewa	
CHIO	***Chionophila***	**snowlover**	
Chja	*jamesii* Benth.	James snowlover	
CHOR	***Chorispora***		
Chte1	*tenella* (Pall.) DC.		
CHRY2	***Chrysopsis* = *Heterotheca***	**goldaster**	
Chvi2	*villosa* (Pursh) DC.	hairy goldaster	
	= *Heterotheca villosa* (Pursh) Shinners		
	= *C. ballardii* Rydb.		
	= *C. foliosa* Nutt.		
	= *C. hirsutissima* Greene		
	= *C. hispida* (Hook.) DC.		
	= *C. pumila* Greene		
Chvi4	*viscida* (Gray) Greene		
	= *Heterotheca viscida* (Gray) Harms		
CICH	***Cichorium***	**chicory**	
Ciin	*intybus* L.	common chicory	chicory
CICU	***Cicuta***	**waterhemlock**	
Cido	*douglasii* (DC.) C. + R.	Douglas waterhemlock	wild parsnip, cowbane
	= *C. occidentalis* Greene		
CIRC	***Circaea***	**circaea**	**enchanters-night**
Cial	*alpina* L.	alpine circaea	enchanters-night
	= *C. pacifica* Asch. + Magnus		
CIRS	***Cirsium***	**thistle**	
Ciar	*arizonicum* (Gray) Petrak	Arizona thistle	
Ciar1	*arvense* (L.) Scop.	Canada thistle	
Cice	*centaureae* (Rydb.) K. Schum.		
	= *C. americanum* Daniels		
Ciea	*eatonii* (Gray) Robins.		
Cifo	*foliosum* (Hook.) DC.	elk thistle	
	= *C. coloradense* (Rydb.) Cockll.		
	= *C. drummondii* T. + G.		
	= *C. drummondii* var. *acaulescens* (Gray) Macbr.		
Cigr	*grahamii* Gray		deep-purple thist
Cine	*neomexicanum* Gray		
Cipa1	*pallidum* Woot. + Standl.		
Cipa2	*parryi* (Gray) Petrak		
Cipe	*perplexans* Rydb.		
Cipl	*plattense* (Rydb.) Fern.		
Ciro	*rothrockii* (Gray) Petrak		carmine thistle
Cisc	*scopulorum* (Greene) Cockll.		
	= *C. hookerianum* Nutt.		
Cisp	*spathulifolium* Rydb.		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Ciun	*undulatum* (Nutt.) Spreng.	wavyleaf thistle	
Ciunm	*megacephalum* (Gray) Fern.		
	= *C. megacephalum* Cockll.		
Civu	*vulgare* (Savi) Airy-Shaw		
	= *C. lanceolatum* of some manuals		
CISS	***Cissus***	**treebine**	
Citr	*trifoliata* L.		
CLAR	***Clarkia***	**clarkia**	**polkadot clarkia**
Clrh	*rhomboidea* Hook.		
CLAY	***Claytonia***	**springbeauty**	
Clla	*lanceolata* Pursh	lanceleaf springbeauty	
	= *C. rosea* Rydb.		
Clme	*megarrhiza* (Gray) Parry	alpine springbeauty	
CLEO	***Cleome***	**spiderflower**	**beeplant**
Cllu	*lutea* Hook.	yellow spiderflower	yellow beeplant
Clse	*serrulata* Pursh	bee spiderflower	RockyMountain beeplant
CLEO1	***Cleomella***		
Clob	*obtusifolia* Torr. + Frem.		Mohave stinkweed
CLIT	***Clitoria***	**pigeonwings**	
Clma	*mariana* L.	Atlantic pigeonwings	butterfly-pea
COLL	***Collinsia***	**collinsia**	
Copa	*parviflora* Lindl.	littleflower collinsia	
	= *C. tenella* Piper		
COLL1	***Collomia* = *Gilia*, in part**	**collomia**[25]	
Cogr	*grandiflora* Lindl.	bigflower collomia[26]	bigflower gilia
	= *Gilia grandiflora* Gray		
Coli	*linearis* Nutt.	slenderleaf collomia[27]	slenderleaf gilia
	= *Gilia linearis* Gray		
COMA	***Comandra* Nutt.**	**comandra**	
Coum	*umbellata* (L.) Nutt.	common comandra	bastard toadflax
Coump	*pallida* (DC.) M.E. Jones		
	= *C. pallida* DC.		
COMM	***Commelina***	**dayflower**	
Codi	*dianthifolia* Delile	birdbill dayflower	
Coer	*erecta* L.	erect dayflower	
Coerc	*crispa* (Woot.) Palmer + Steyerm.	curlyleaf dayflower	
	= *C. crispa* Woot.		
CONI	***Conioselinum***	**hemlockparsley**	
Cosc	*scopulorum* (Gray) C. + R.	RockyMountain hemlockparsley[28]	hemlock
	= *Ligusticum scopulorum* Gray		
CONI1	***Conium***	**poisonhemlock**	
Coma1	*maculatum* L.	poisonhemlock	
CONO	***Conopholis***		
Come3	*mexicana* Gray		squawroot

[25] Suggested common name.
[26] Suggested common name.
[27] Suggested common name.
[28] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
CONV	***Convolvulus***	**glorybind**	**bindweed**
Coar1	*arvensis* L.	European glorybind	field bindweed
Coin	*incanus* Vahl	Nebraska glorybind	climbing bindwee
	= *C. equitans* Benth.		
Cose	*sepium* L.	hedge glorybind	hedge bindweed
CONY	***Conyza***	**rayless aster**	
Coca	*canadensis* (L.) Cronq.	horseweed fleabane	
	= *Erigeron canadensis* L.		
Coco	*coulteri* Gray	Coulter rayless-aster	
Cosc1	*schiedeana* (Less.) Cronq.		
	= *Erigeron schiedeanus* Less.		
CORA	***Corallorhiza***	**coralroot**	
Coma2	*maculata* Raf.	spotted coralroot	
	= *C. multiflora* Nutt.		
Cost2	*striata* Lindl.	hooded coralroot	
Costv	*vreelandii* (Rydb.) L.O. Williams		
	= *C. vreelandii* Rydb.		
Cotr	*trifida* Chat.	early coralroot	
Cowi	*wisteriana* Conrad	Wister coralroot	
CORD	***Cordylanthus***	**birdbeak**	**clubflower**
Cora2	*ramosus* Benth.	bushy birdbeak	brushy clubflower
Cowr	*wrightii* Gray	Wright birdbeak	plumeweed clubflower
CORE	***Coreopsis***	**coreopsis**	**tickseed**
Coca1	*cardaminefolia* (DC.) T. + G.	cardamine coreopsis	cardamine ticksee
Codo	*douglasii* (DC.) Hall	Douglas coreopsis	Douglas tickseed
Coti	*tinctoria* Nutt.	plains coreopsis	plains tickseed[29]
CORI	***Corispermum***	**tickseed**	**bugseed**
Cohy	*hyssopifolium* L.	hyssopleaf tickseed	hyssopleaf bugsee
Coni	*nitidum* Kit.		nits bugseed
CORY1	***Corydalis***	**corydalis**	
Coau	*aurea* Willd.	golden corydalis	
Coauo	*occidentalis* Engelm.	mountain corydalis	
Coca4	*caseana* Gray	fitweed corydalis	Brandegee coryd
Cocab	*brandegei* (Wats.) Ownbey (ssp.)		
COSM	***Cosmos***	**cosmos**	
CREP	***Crepis***	**hawksbeard**	
Crac	*acuminata* Nutt.	tapertip hawksbeard	
Crat	*atribarba* Heller		
	= *C. gracilis* Rydb.		
	= *C. intermedia* var. *gracilis* Gray		
Crmo	*modocensis* Greene	Modoc hawksbeard[30]	Yellowstone hawksbeard
	= *C. scopulorum* Cov.		
Crna	*nana* Richards.	tiny hawksbeard	
	= *Youngia nana* Rydb.		
Croc	*occidentalis* Nutt.	western hawksbeard	
Crru	*runcinata* (James) T. + G.	dandelion hawksbeard	
Crrug	*glauca* (Nutt.) Babc. + Stebbins (ssp.)		
	= *C. glauca* T. + G.		
CROT1	***Crotalaria***	**crotalaria**	**rattlebox**
Crpu	*pumila* Ortega	low crotalaria	rusty rattlebox

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[29] Tickseed is accepted name for *Corispermum*.

[30] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Crsa	*sagittalis* L.	arrow crotalaria	yellow rattlebox[31]
CROT2	***Croton*** **See also under TREES AND SHRUBS**	**croton**	
Crco	*corymbulosus* Engelm. = *C. pottsii* Muell. Arg.	leatherweed croton	
Crte	*texensis* (Klotsch) Muell. Arg.	Texas croton	doveweed croton
CRYP	***Cryptantha*** **=** ***Oreocarya*****, in part**	**cryptantha**	**hiddenflower**
Craf	*affinis* (Gray) Greene		
Cram	*ambigua* (Gray) Greene = *C. multicaulis* A. Nels.		
Cran	*angustifolia* (Torr.) Greene		
Crce	*celosioides* (Eastw.) Pays. = *C. bradburiana* Pays. = *C. sheldonii* Pays. = *Oreocarya glomerata* Greene		desert hiddenflower
Crcr	*crassisepala* (T. + G.) Greene		plains hiddenflower
Crfl1	*flava* (A. Nels.) Pays.		
Crfl	*flavoculata* (A. Nels.) Pays.		
Crfu	*fulvocanescens* (Gray) Pays.		beggarlice hiddenflower
Crgr	*gracilis* Osterh.		
Crja	*jamesii* (Torr.) Pays. = *Oreocarya cinerea* Greene = *Oreocarya multicaulis* Greene = *Oreocarya suffruticosa* Greene	James cryptantha	James hiddenflower
Crjap	*pustulosa* (Rydb.) Harrington = *C. pustulosa* Pays.		
Crmi	*micrantha* (Torr.) Johnst. = *Eremocarya micrantha* Greene		desertnut
Crmi1	*minima* Rydb.		
Crpt	*pterocarya* (Torr.) Greene		
Crra	*racemosa* (Wats.) Greene	forgetmenot cryptantha	forgetmenot hiddenflower
Crse1	*sericea* (Gray) Pays. = *Oreocarya sericea* Greene = *O. argentea* Rydb.		
Crse	*setosissima* (Gray) Pays.		
Crst1	*stricta* (Osterh.) Pays. = *Oreocarya stricta* Osterh.		
Crth	*thyrsiflora* (Greene) Pays.		
Crvi	*virgata* (Porter) Pays. = *Oreocarya virgata* Greene = *O. spicata* Rydb.		
Crwa	*watsonii* (Gray) Greene	Watson cryptantha	
CRYP1	***Cryptogramma***	**rockbrake**	
Crcr1	*crispa* Hook. = *C. acrostichoides* R. Br. = *C. crispa* var. *acrostichoides* C. B. Clarke	American rockbrake	
Crst	*stelleri* (Gmel.) Prantl	slender rockbrake	
CUCU	***Cucurbita***		
Cufo	*foetidissima* H.B.K.	buffalogourd	calabazilla
Cupa	*palmata* Wats.		coyote-melon
CUSC	***Cuscuta***	**dodder**	
Cuca	*campestris* Yunck.		legume dodder
Cuco	*coryli* Engelm.	hazel dodder	
Cuin	*indecora* Choisy	bigseed alfalfa dodder	bigseed dodder

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[31] Rattlebox is accepted common name for *Daubentonia.*

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Cusa	*salina* Engelm.	saltmarsh dodder	
CYCL	***Cycloloma***	**ringwing**	
Cyan	*atriplicifolium* (Spreng.) Coult.	tumble ringwing	
CYMO	***Cymopterus***	**wafer-parsnip**	
Cyac1	*acaulis* (Pursh) Raf.		
	= *C. parryi* M.E. Jones		
	= *C. lucidus* Osterh.		
	= *C. leibergii* C. + R.		
Cybu1	*bulbosus* A. Nels.		
	= *Phellopterus camporum* Rydb.		
	= *Phellopterus purpurascens* var. *eastwoodea* C. + R.		
	= *Phellopterus utahensis* Woot. + Standl.		
Cyfe1	*fendleri* Gray	chimaya	
Cylo	*longipipes* Wats.		
	= *Aulospermum angustum* Osterh.		
	= *Cogswellia lapidosa* Rydb.		
Cymo	*montanus* (Nutt.) T. + G.	chimaya	
	= *Phellopterus macrocarpus* Osterh.		
Cymu	*multinervatus* Tidest.		corkwing wafer-parsn
Cyne	*newberryi* (Wats.) M.E. Jones		sweetroot wafer-parsn
Cypu	*purpureus* Wats.		purple wafer-parsn
	= *Coriophyllus betheli* Rydb.		
CYNO	***Cynoglossum***	**houndstongue**	
Cyoc	*occidentale* Gray	western houndstongue	
Cyof	*officinale* L.	common	houndstongue
CYPR	***Cypripedium***	**ladyslipper**	
Cyca	*calceolus* L.	European ladyslipper	
Cycap	*pubescens* (Willd.) Correll	yellow European ladyslipper	
	= *C. parviflorum* Salisb.		
	= *C. veganum* Cockll. + Barker		
Cyfa	*fasciculatum* Wats.	brownie ladyslipper	
	= *C. knightae* A. Nels.		
CYST	***Cystopteris***	**bladderfern**	
Cybu	*bulbifera* (L.) Bernh.	berry bladderfern	bulblet bladderfe
Cyfr	*fragilis* (L.) Bernh.	brittle bladderfern	
DALE	***Dalea*** **See also under TREES AND SHRUBS**	**dalea**	**indigobush, pea-bush**
Daar	*argyraea* Gray	silver dalea	silver indigobush
Daau	*aurea* Nutt.	silktop dalea	silktop indigobus
Daen	*enneandra* Nutt.		
	= *Parosela enneandra* Britt.		
Dafo	*formosa* Torr.	feather dalea	feather indigobu
Dafr	*frutescens* Gray	black dalea	black indigobush
Daja	*jamesii* (Torr.) T. + G.	James dalea	
	= *Parosela jamesii* Vail		
	= *Parosela porteri* A. Nels.		
Dana	*nana* Torr.	dwarf dalea	dwarf indigobush
Dapa2	*parryi* T. + G.	Parry dalea	Parry indigobush

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Dapo	*polygonoides* Gray	sixweeks dalea	sixweeks indigobush
Dasc	*scoparia* Gray	broom dalea	broom indigobush
Dawr	*wrightii* Gray	Wright dalea	Wright indigobush
DATU	***Datura***	**datura**	**thornapple**
Dame	*meteloides* Dunal	sacred datura	
Daqu	*quercifolia* H.B.K.	oakleaf datura	
Dast	*stramonium* L.	jimsonweed datura	jimsonweed
DAUC	***Daucus***	**carrot**	
Dapu	*pusillus* Michx.	southwestern carrot	carrot, wild carrot
DELP	***Delphinium***	**larkspur**	
Deal	*alpestre* Rydb.	alpine larkspur	
Dean1	*andesicola* Ewan		
Deana	*amplum* Ewan (ssp.)		
	= *D. sierrae-blancae* ssp. *amplum* Ewan		
Deba1	*barbeyi* (Huth) Huth	Barbey larkspur	
	= *D. cockerellii* A. Nels.		
Debi	*bicolor* Nutt.	little larkspur	purple larkspur
Deca1	*carolinianum* Walt.	Carolina larkspur	
Dede	*depauperatum* Nutt.	slim larkspur	
	= *D. diversifolium* Greene		
	= *D. scopulorum* var. *diversifolium* Davis		
Dege	*geraniifolium* Rydb.	geranium larkspur	
Dege1	*geyeri* Greene	Geyer larkspur	
Degl	*glaucum* Wats.		
	= *D. scopulorum* var. *glaucum* Gray		
Deme	*menziesii* DC.	Menzies larkspur	
Dene	*nelsonii* Greene	pine larkspur	
	= *D. pinetorum* Tidest.		
	= *D. dumetorum* Greene		
Denu	*nuttallianum* Walp.	Nuttall larkspur	
Deoc	*occidentale* Wats.	duncecap larkspur	
	= *D. multiflorum* Rydb.		
	= *D. reticulatum* Rydb.		
Deocc	*cucullatum* (A. Nels.) Ewan (ssp.)		
	= *D. cucullatum* A. Nels.		
Deocq	*quercicola* Ewan (ssp.)		
Depa	*parishii* Gray		
	= *D. amabile* Tidest.		
Dera	*ramosum* Rydb.	branched larkspur	
	= *D. elongatum* Rydb.		
Dero1	*robustum* Rydb.	giant larkspur	
Desc2	*scaposum* Greene	barestem larkspur	
Desi	*sierrae-blancae* Woot.	Whitemountain larkspur	
Devi1	*virescens* Nutt.		plains larkspur
Devip	*penardii* (Huth) Ewan (ssp.)	Penard plains larkspur	
	= *D. carolinianum* var. *penardii* A. Nels.		
	= *D. penardii* Huth		
DESC1	***Descurainia* = *Sophia* = *Sisymbrium*, in part**	**tansymustard**	
Deca2	*californica* (Gray) Schulz		
Depi	*pinnata* (Walt.) Britt.	pinnate tansymustard	
	= *Sisymbrium canescens* Nutt.		
	= *Sisymbrium pinnatum* Greene		
	= *Sophia pinnata* Howell		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Depif	*filipes* (Gray) Peck	slimstem tansymustard	
	= *D. longipedicellata* Schulz		
	= *Sophia filipes* Heller		
	= *Sophia gracilis* Rydb.		
Depih	*halictorum* (Cockll.) Detling		
	= *Sophia andrenarum* Cockll.		
	= *Sophia halictorum* Cockll.		
Depio	*ochroleuca* (Woot.) Shinners	creamy tansymustard	
	= *D. menziesii* var. *ochroleuca* Schulz		
	= *Sophia ochroleuca* Woot.		
Deri	*richardsonii* (Sweet) Schulz	Richardson tansymustard	
	= *D. serrata* Schulz		
Derii	*incisa* (Engelm.) Detling (ssp.)	western tansymustard	
	= *Sisymbrium incisum* Engelm.		
	= *Sophia incisa* Greene		
	= *D. incisa* Britt.		
	= *Sophia leptophylla* Rydb.		
Derip	*procera* (Greene) Detling (ssp.)		
	= *Sophia hartwegiana* of some manuals		
	= *Sophia procera* Greene		
Deriv	*viscosa* (Rydb.) Detling		
	= *Sophia viscosa* Rydb.		
Deso	*sophia* (L.) Webb	flixweed tansymustard	flixweed
DESM	***Desmanthus***	**bundleflower**	
Deco	*cooleyi* (Eat.) Trel.	James bundleflower	
	= *D. jamesii* T. + G.		
Devi2	*virgatus* (L.) Willd.	rayado bundleflower	
DESM1	***Desmodium* = *Meibomia***	**tickclover**	**beggarticks**
Dean	*angustifolium* (H.B.K.) DC.	narrowleaf tickclover	spikeleaf tickclover
Deba	*batocaulon* Gray	bush tickclover[32]	bat tickclover
Deci	*cinerascens* Gray	Sonora tickclover[33]	
Degr	*grahamii* Gray	Graham tickclover	
Dene1	*neomexicanum* Gray	NewMexican tickclover	
Dero	*rosei* Schubert	Roses tickclover	
DICE	***Dicentra***	**bleedingheart**	
Dicu	*cucullaria* (L.) Bernh.	Dutchmans-breeches	
DIOD	***Diodia***	**buttonweed**	**poor joe**
Dite	*teres* Walt.	rough buttonweed	
DIPS	***Dipsacus***	**teasel**	
Disy	*sylvestris* Huds.	Venuscup teasel	
DISP	***Disporum***	**fairybells**	
Ditr	*trachycarpum* (Wats.) B. + H.	wartberry fairybells	
DITH	***Dithyrea***	**spectaclepod**	
Diwi	*wislizenii* Engelm.	Wislizenus spectaclepod	
DODE	***Dodecatheon***	**shootingstar**	
Doal	*alpinum* (Gray) Greene	alpine shootingstar	
Dode	*dentatum* Hook.	dentate shootingstar	

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[32] Suggested common name.
[33] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Dodee	*ellisiae* (Standl.) Thompson (ssp.)		Ellis shootingstar
Doje	*jeffreyi* Van Houtte	Jeffrey shootingstar	
	= *D. tetrandrum* Greene		
Dopu	*pulchellum* (Raf.) Merr.	darkthroat shootingstar	
	= *D. cusickii* Greene		
	= *D. multiflorum* Rydb.		
	= *D. pauciflorum* Greene		
	= *D. philoscia* A. Nels.		
	= *D. radicatum* Greene		
	= *D. sinuatum* Rydb.		
DOUG	***Douglasia***	**douglasia**	
Domo	*montana* Gray	mountain douglasia	
DRAB	***Draba***	**draba**	**whitlowgrass, whitlowwort**
Drau	*aurea* Vahl	golden draba	golden whitlowgrass
	= *D. luteola* Greene		
	= *D. aureiformis* Rydb.		
	= *D. decumbens* Rydb.		
Drcr1	*crassa* Rydb.		
	= *D. chrysantha* Wats., in part		
Drcr	*crassifolia* Grah.	hairy whitlowgrass	
	= *D. parryi* Rydb.		
Drcu	*cuneifolia* T. + G.		
Drde	*densifolia* Nutt.		
Drex	*exunguiculata* (Schulz) C.L. Hitchc.		
	= *D. chrysantha* Wats., in part		
Drfl	*fladnizensis* Wulfen	arctic draba	
Drhe	*helleriana* Greene		
Drla	*lanceolata* Royle	lanceolate draba	
	= *D. cana* Rydb.		
Drne	*nemorosa* L.	woods draba	woods whitlowgrass
Drol	*oligosperma* Hook.		
Drolp	*pectinipila* (Rollins) C.L. Hitchc.		
	= *D. pectinipila* Rollins		
Drre1	*rectifructa* C. L. Hitchc.		
	= *D. montana* Wats.		
Drre	*reptans* (Lam.) Fern.	Carolina draba	
	= *D. caroliniana* Walt.		
Drsp	*spectabilis* Greene		
Drst	*stenoloba* Ledeb.	shiny draba	
	= *D. nitida* Greene		
Drstn	*nana* (Schulz) C. L. Hitchc.	shiny draba	shiny whitlowgrass
	= *D. nitida* Greene		
Drst1	*streptocarpa* Gray		
DRAC	***Dracocephalum***	**dragonhead**	**false-dragonhead** [34]
DRYA	***Dryas***	**dryad**	
Droc	*octopetala* L.	Mt. Washington dryad	
DRYM	***Drymaria***	**drymary**	**seccomaria**
Drfe	*fendleri* Wats.		Fendler drymary
Drpa	*pachyphylla* Woot. + Standl.	thickleaf drymary	poison drymary
Drte	*tenella* Gray		
DRYO	***Dryopteris***	**woodfern**	**shieldfern**

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[34] False-dragonhead is common name for *Moldavica.*

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
DYSS	***Dyssodia***	**dogweed**	
Dypa	*papposa* (Vent.) Hitchc. = *Boebera papposa* Rydb.	prairie dogweed	
ECHI5	***Echinacea***	**echinacea**	
Ecan	*angustifolia* DC. = *Brauneria angustifolia* Heller = *E. pallida* var. *angustifolia* Cronq.	blacksamson echinacea	
Ecpa	*pallida* Nutt. = *Brauneria pallida* Britt.		pale echinacea
ECHI6	***Echinocystis***	**mockcucumber**	
Eclo	*lobata* (Michx.) T. + G. Gray	wild mockcucumber	mock-cucumb
ECHI9	***Echinopepon***		
Ecwr	*wrightii* (Gray) Wats.		spinycucumbe
ECHI7	***Echium***	**vipersbugloss**	
Ecvu	*vulgare* L.	common vipersbugloss	blueweed
ELLI	***Ellisia***	**ellisia**	
Elny	*nyctelea* L. = *Macrocalyx nyctelea* Kuntze		
ELOD	***Elodea* = *Anacharis***		
EPIL	***Epilobium* = *Chamaenerion***	**willowweed**	
Epad	*adenocaulon* Hausskn.	sticky willowweed	
Epado	*occidentale* Trel. = *E. occidentale* Rydb.		
Epadp	*parishii* (Trel.) Munz = *E. palmeri* Lev.		
Epal	*alpinum* L. = *E. anagallidifolium* Lam.	alpine willowweed	
Epan	*angustifolium* L. = *Chamaenerion angustifolium* Scop.	fireweed	blooming-sally
Epbr	*brevistylum* Barbey	Sierra willowweed	
Epcl	*clavatum* Trel.		
Epgl	*glandulosum* Lehm.		
Epha	*halleanum* Hausskn.		
Epho	*hornemannii* Reichenb.	Hornemann willowweed	
Epla	*latifolium* L.	red willowweed	
Epmi	*minutum* Hook.	minute fireweed	
Eppa2	*palustre* L. = *E. wyomingense* A. Nels.		
Eppa	*paniculatum* Nutt.	autumn willowweed	
Epru	*rubescens* Rydb.		
Epsa	*saximontanum* Hausskn. = *E. ovatifolium* Rydb.		
Epst	*stramineum* Rydb.		
EPIP	***Epipactis***		
Epgi	*gigantea* Hook.	stream epipactis	helleborine
EQUI	***Equisetum***	**horsetail**	
Eqar	*arvense* L.	field horsetail	
Eqhy	*hyemale* L. = *E. praealtum* Raf.	scouringrush	
Eqhya	*affine* (Engelm.) A. A. Eat.	stout scouringrush	
Eqla	*laevigatum* A. Br. = *E. kansanum* Schaffn.	smooth horsetail	

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Eqpa	*palustre* L.	marsh horsetail	
Eqsy	*sylvaticum* L.	sylvan horsetail	
Eqva	*variegatum* Weber + Mohr	variegated horsetail	
ERIG	***Erigeron***	**fleabane**	**wild-daisy**
Erac	*acris* L.	bitter fleabane	
Erbe	*bellidiastrum* Nutt.		
Erca1	*caespitosus* Nutt.	tufted fleabane	
Erca3	*canus* Gray = *Wyomingia cana* A. Nels.	hoary fleabane	
Erco1	*compositus* Pursh	fernleaf fleabane	
Erco3	*corymbosus* Nutt.	purpledaisy fleabane	
Erco4	*coulteri* Porter	Coulter fleabane	
Erdi2	*divergens* T. + G. = *E. wootonii* Rydb.	spreading fleabane	
Erea	*eatonii* Gray = *E. microlonchus* Greene	Eaton fleabane	
Erel	*elatior* (Gray) Greene	tall fleabane	
Eren	*engelmannii* A. Nels.	Engelmann fleabane	
Erfl1	*flagellaris* Gray = *E. stolonifer* Greene	trailing fleabane	
Erfo	*formosissimus* Greene		
Erfov	*viscidus* (Rydb.) Cronq. = *E. viscidus* Rydb. = *E. eximius* Greene = *E. rubicundus* Greene	viscid fleabane	
Ergl	*glabellus* Nutt. = *E. earlei* Rydb. = *E. asper* Nutt.	smooth fleabane	
Erglp	*pubescens* Hook. = *E. consobrinus* Greene	Colorado fleabane	
Erle1	*leiomerus* Gray		
Erlo	*lonchophyllus* Hook. = *E. minor* Rydb.	spearleaf fleabane	
Erme1	*melanocephalus* A. Nels.		
Erne1	*nematophyllus* Rydb.		
Eroc	*ochroleucus* Nutt. = *E. montanus* Rydb.		
Erpe1	*peregrinus* (Pursh) Greene	peregrine fleabane	
Erpec	*callianthemus* (Greene) Cronq. (ssp.) = *E. salsuginosus* Gray		
Erph1	*philadelphicus* L.	Philadelphia fleabane	
Erpi2	*pinnatisectus* (Gray) A. Nels.	pinnate fleabane	
Erpu1	*pulchellus* Michx.	poorrobins-plantain	plantain fleabane
Erpu2	*pumilus* Nutt. = *E. concinnus* T. + G.	low fleabane	
Ersi1	*simplex* Greene = *E. leucotrichus* Rydb.		
Ersp	*speciosus* (Lindl.) DC.	Oregon fleabane	
Erspm	*macranthus* (Nutt.) Cronq. = *E. macranthus* Nutt.	aspen fleabane	
Ersu	*subtrinervis* Rydb. = *E. incanescens* Rydb.	threenerve fleabane	
Ersu2	*superbus* Rydb.		
Erur	*ursinus* D. C. Eat.	BearRiver fleabane	bear fleabane
Erva	*vagus* Rydb.		
Erve	*vetensis* Pays. = *E. glandulosus* Porter = *E. porteri* Blake		

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
ERIO1	***Eriogonum***	**eriogonum**	**buckwheat,**[35] **sulphur flo** **umbrella pl**
Eral	*alatum* Torr.	wing eriogonum	winged buckwhe
Eran1	*annuum* Nutt.	annual eriogonum	annual buckwhe
Erbr	*brevicavle* Nutt.		
	= *E. campanulatum* Nutt.		
Erca4	*caespitosum* Nutt.	mat eriogonum	mat buckwheat
Erce	*cernuum* Nutt.	nodding eriogonum	nodding buckwh
Erch	*chrysocephalum* Gray	goldball eriogonum	goldball buckwh
Erel2	*elatum* Benth.	rush eriogonum	
Erfa	*fasciculatum* Benth.	flattop eriogonum	
Erfl2	*flavum* Nutt.	yellow eriogonum	yellow buckwhea
	= *E. crassifolium* Benth.		
	= *E. chloranthum* Greene		
	= *E. piperi* Greene		
Erhi	*hieracifolium* Benth.		
Erho	*hookeri* Wats.		
	= *E. deflexum* ssp. *hookeri* Stokes		
Erin2	*inflatum* Torr. + Frem.	deserttrumpet eriogonum	deserttrumpet buckwheat
Erja	*jamesii* Benth.	James eriogonum	antelope-sage buckwheat
Erjo	*jonesii* Wats.		
Erla	*lachnogynum* Torr.		
Erlo1	*lonchophyllum* T. + G.	spearleaf eriogonum	
Ermi	*microthecum* Nutt.	slenderbush eriogonum	slenderbush buckwheat
	= *E. effusum* Nutt.		
Ermu	*multiceps* Nees		
Ernu3	*nudicaule* (Torr.) Small		
Ernu2	*nudum* Benth.	barestem eriogonum	barestem buckw
Erov	*ovalifolium* Nutt.	cushion eriogonum	cushion buckwh
	= *E. ochroleucum* Small		
	= *E. ovalifolium* ssp. *ochroleucum* Stokes		
	= *E. ovalifolium* var. *ochroleucum* (small) Peck		
Erph	*pharnaceoides* Torr.	wirestem eriogonum	wirestem buckw
Erpo	*polycladon* Benth.	sorrel eriogonum	sorrel buckwhea
Erra	*racemosum* Nutt.	redroot eriogonum	redroot buckwh
Ersa1	*salicinum* Greene		
	= *E. effusum* ssp. *salicinum* Stokes		
Ersi	*simpsonii* Benth.		
	= *E. effusum* ssp. *simpsonii* Stokes		
Ersp2	*sphaerocephalum* Benth.		
Erum	*umbellatum* Torr.	sulfur eriogonum	sulfur buckwhe
	= *E. neglectum* Greene		
	= *E. rydbergii* Greene		
	= *E. stellatum* Benth.		
	= *E. subalpinum* Greene		
Ervi	*vimineum* Dougl.	broom eriogonum	broom buckwhe
Erwr	*wrightii* Torr.	Wright eriogonum	Wright buckwh
ERIO2	***Eriophyllum***	**eriophyllum**	**woollydaisy**
Erco5	*confertiflorum* (DC.) Gray	goldenyarrow eriophyllum	
Erla1	*lanatum* (Pursh) Forbes	goldenyarrow woollydaisy	
Erlai	*integrifolium* (Hook.) Smiley		

[35] Buckwheat is the officially accepted common name for *Fagopyron*.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
ERIT	***Eritrichium***	**alpine forget-me-not**	
Erna	*nanum* (Vill.) Schrad.		
Ernae	*elongatum* (Rydb.) Cronq. = *E. elongatum* Wight = *E. argenteum* Wight = *E. elongatum* var. *argenteum* Johnst.		
EROD	***Erodium***	**heronbill**	
Ercil	*cicutarium* (L.) L'HER.	alfileria	filaree, heronsbill, pinclover
Erte	*texanum* Gray	Texas heronbill	
ERYS	***Erysimum* = *Cheirinia* = *Cheiranthus*, in part**	**erysimum**	**wallflower**[36]
Eras	*asperum* (Nutt.) DC. = *E. asperrimum* Rydb. = *E. argillosum* Rydb. = *E. elatum* Nutt.	plains erysimum	plains wallflower
Erca5	*capitatum* (Dougl.) Greene = *E. wheeleri* Rothr.	coast erysimum	
Erch3	*cheiranthoides* L.	treacle erysimum	treacle wallflower
Erin4	*inconspicuum* (Wats.) MacM. = *E. parviflorum* Nutt.		
Erni	*nivale* (Greene) Rydb. = *E. radicatum* Rydb.	snowy erysimum	
Erocl	*occidentale* (Wats.) Robins.	low erysimum	low wallflower
Erre	*repandum* L.	spreading erysimum	spreading wallflower
ERYT1	***Erythronium***	**fawnlily**	**dogtooth-violet**
Ergr2	*grandiflorum* Pursh = *E. idahoense* St. John + Jones = *E. obtusatum* Goodd. = *E. parviflorum* Goodd. = *E. utahense* Rydb.	lambstongue fawnlily	
ESCH	***Eschscholtzia***	**goldpoppy**	
Esca	*californica* Cham.	Californiapoppy	
Esgl	*glyptosperma* Greene	desert goldpoppy	
Esme	*mexicana* Greene	Mexican goldpoppy	
Esmi	*minutiflora* Wats.	little goldpoppy	
EUPA	***Eupatorium***	**eupatorium**	**thoroughwort**
Euhe2	*herbaceum* (Gray) Greene = *E. arizonicum* Greene		white thoroughwort
Euma2	*maculatum* L. = *E. bruneri* Gray	spotted joepyeweed	
Euwr	*wrightii* Gray		spreading thoroughwort
EUPH	***Euphorbia* = *Chamaesyce* = *Tithymalus***	**euphorbia**	**spurge**[37]
Eual	*albomarginata* T. + G.	whitemargin euphorbia	rattlesnake-weed
Euca	*capitellata* Engelm.	head euphorbia	head spurge
Eude	*dentata* Michx. = *Poinsettia dentata* Kl. + Gke.	toothed euphorbia	toothed poinsettia
Euge	*geyeri* Engelm. = *chamaesyce geyeri* Small	Geyer euphorbia	

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[36] Wallflower is accepted common name for species of *Cheiranthus*.

[37] Spurge is widely used as the common name for the whole family of *Euphorbiaceae* and is not distinctive for any one genus of the family.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
Eugl	*glytosperma* Engelm. = *Chamaesyce glyptosperma* Small	ridgeseed euphorbia	ridgeseed spu
Euhel	*heterophylla* L.	painted euphorbia	painted spurg
Eula2	*lathyrus* L.	caper euphorbia	caper spurge, moleweed, moleplant
Eumal	*marginata* Pursh = *Dichrophyllum marginatum* Kl. + Gke. = *Agaloma marginata* Love + Love	snow-on-the mountain euphorbia	snow-on-the mountain
Eumi	*missurica* Raf. = *E. petaloidea* Engelm.	Missouri euphorbia	
Eupe	*peplus* L.	petty euphorbia	petty spurge
Euro	*robusta* (Engelm.) Small = *E. montana* Engelm. = *E. robusta* var. *montana* Engelm.	robust euphorbia	robust spurge
Eusel	*serpens* H.B.K. = *Chamaesyce serpens* Small	serpent euphorbia	serpent spurge
Euse2	*serpyllifolia* Pers. = *Chamaesyce serpyllifolia* Small = *E. rugulosa* Greene = *C. albicaulis* Rydb.	thymeleaf euphorbia	thymeleaf spurg
Euse3	*setiloba* Engelm.	Yuma euphorbia	Yuma spurge
EUST	***Eustoma***	**prairiegentian**	
Eugr	*grandiflorum* (Raf.) Shinners = *E. russellianum* Sweet		
EVAX	***Evax***	**fluffweed**	
Evve	*verna* Raf. = *E. multicaulis* DC. = *Filago nivea* Small		
Evpr	*prolifera* DC. = *Diaperia prolifera* Nutt. = *Filago prolifera* Britt.		
EVOL	***Evolvulus***	**evolvulus**	
Evnu	*nuttallianus* R. + S. = *E. argenteus* Pursh = *E. pilosus* Nutt.	Nuttall evolvulus	
FILA	***Filago* = *Oglifa***	**fluffweed**	
Fica	*californica* Nutt.	Californica fluffweed	
FLOE	***Floerkea***	**falsemermaid**	
FRAG	***Fragaria***	**strawberry**	
Frbr	*bracteata* Heller = *F. vesca* var. *bracteata* Davis	bracted strawberry	
Frvel	*vesca* L.	European strawberry	
Frvea	*americana* Porter = *F. americana* Britt.		
Frvec	*crinita* C. L. Hitchc. = *F. californica* C. + S. = *F. vesca* ssp. *californica* Staudt.		
Frov	*ovalis* (Lehm.) Rydb. = *F. glauca* Rydb. = *F. ovalis* var. *glauca* Wats. = *F. virginiana* var. *ovalis* Davis		wild strawberry
Frvi	*virginiana* Duchn.	Virginia strawberry	
Frvii	*illinoensis* (Prince) Gray = *F. grayana* E. Vilm.	Illinois strawberry	

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Frvip	*platypetala* Hall = *F. platypetala* Rydb. = *F. virginiana* ssp. *platypetala* Staudt.		
FRAN	***Franseria* = *Ambrosia*, in part**	**bursage**	
Frac	*acanthicarpa* (Hook.) Cov. = *Ambrosia acanthicarpa* Hook.		
Frdi	*discolor* Nutt. = *A. tomentosa* Nutt.		
Frdu	*dumosa* Gray = *A. dumosa* (Gray) Payne	white bursage	
Frer	*eriocentra* Gray = *A. eriocentra* (Gray) Payne	woolly bursage	
Fril	*ilicifolia* Gray = *A. ilicifolia* (Gray) Payne	hollyleaf bursage	
Frte	*tenuifolia* Harv. + Gray = *A. confertiflora* DC.	slimleaf bursage	
Frto	*tomentosa* Gray = *A. grayi* (A. Nels.) Shinners		
FRAS	***Frasera* = *Swertia*, in part**		
Fral	*albomarginata* Wats. = *Swertia albomarginata* Kuntze		
Frpal	*paniculata* Torr. = *F. utahensis* M. E. Jones		
Frsp	*speciosa* Dougl. = *Frasera macrophylla* Greene = *Swertia radiata* Kuntze		
FRIT	***Fritillaria***	**fritillary**	
Frat	*atropurpurea* Nutt.	purplespot fritillary	
Frpu	*pudica* (Pursh) Spreng.	yellow fritillary	
FROE	***Froelichia***		**snakecotton**
Frgrl	*gracilis* (Hook.) Moq.		
GAIL	***Gaillardia***	**gaillardia**	**blanketflower**
Gaar	*aristata* Pursh	common perennial gaillardia	
Gapi	*pinnatifida* Torr.		blanketflower
Gapu	*pulchella* Foug.	rosering gaillardia	firewheel, rosering
GALA	***Galactia***	**milkpea**	
Gawrl	*wrightii* Gray	Wright milkpea	milkpea
GALE	***Galeopsis***	**hempnettle**	
Gate	*tetrahit* L.	bristlestem hempnettle	
GALI	***Galium***	**bedstraw**	
Gaap	*aparine* L.	catchweed bedstraw	goosegrass bedstraw
Gabil	*bifolium* Wats.	twinleaf bedstraw	
Gabo	*boreale* L.	northern bedstraw	
Game	*mexicanum* H.B.K.		
Gamea	*asperulum* (Gray) Dempst. = *G. asperrimum* Gray		
Gatrl	*trifidum* L.	small bedstraw	
Gatr2	*triflorum* Michx.	sweetscented bedstraw	
GAUR	***Gaura***	**gaura**	**little-primrose, butterfly weed**
Gaco	*coccinea* (Nutt.) Pursh	scarlet gaura	
Gacog	*glabra* (Lehm.) T. + G. = *G. glabra* Lehm.		

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
Gane	*neomexicana* Woot.		
Gapa	*parviflora* Hook.		
GAYO	***Gayophytum***	**groundsmoke**	**baby's breath**
Gadi	*diffusum* T. + G.	bigflower groundsmoke	
Ganu	*nuttallii* T. + G. = *G. intermedium* Rydb.		
Gara1	*racemosum* T. + G. = *G. caesium* T. + G.		
Gara	*ramosissimum* T. + G.		
GENT	***Gentiana* = *Gentianella* = *Gentianopsis*, in part**	**gentian**	
Geaf	*affinis* Hook. = *G. parryi* Engelm.	RockyMountain pleated gentian	pleated gentian
Geal	*algida* Pall. = *G. romanzovii* Bunge		
Geam	*amarella* L. = *Gentiana plebeja* Bunge = *G. scopulorum* Tidest. = *Gentianella amarella* Borner	annual gentian	
Geba	*barbellata* Engelm. = *Gentianella barbellata* (Engelm.) Gillett = *Gentianopsis barbellata* (Engelm.) Iltis	bearded gentian	
Gebi	*bigelovii* Gray	Bigelow gentian	
Geca2	*calycosa* Griseb. = *G. parryi* of some manuals	Rainier pleated gentian	
Gefo	*forwoodii* Gray	Forwood gentian	
Gegr	*grandis* (Gray) Holm	Arizona fringed gentian[38]	fringed gentian
Gehe	*heterosepala* Engelm. = *Gentianella amarella* ssp. *heterosepala* (Engelm.) Gillett		
Gepr	*prostrata* Haenke = *Ericolia prostrata* (Haenke) Borkh. = *G. fremontii* Torr.		
Gest1	*strictiflora* (Rydb.) A. Nels.		
Gete	*tenella* Rottb. = *Comastoma tenella* (Rottb.) Toyokuni = *G. monantha* A. Nels.		
Geth	*thermalis* Kuntze = *Gentiana elegans* A. Nels. = *Gentianopsis thermalis* (Kuntze) Iltis	RockyMountain fringed gentian	Colorado fringe gentian
GERA	***Geranium***	**geranium, crowfoot**	**cranesbill**
Gebi1	*bicknellii* Britt. = *G. carolinianum* var. *longipes* Wats.		
Geca	*caespitosum* James = *G. atropurpureum* Heller		purple geraniu
Geca1	*carolinianum* L.	Carolina geranium	
Gefr	*fremontii* Torr.	Fremont geranium	
Gefrc	*cowenii* (Rydb.) Harrington = *G. cowenii* Rydb.		

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[38] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	COMMON NAMES OTHER
Gepa	*parryi* (Engelm.) Heller	Parry geranium	
	= *G. pattersonii* Rydb.		
Geri	*richardsonii* Fisch. + Trautv.	Richardson geranium	
Gevi	*viscosissimum* Fisch. + Mey.	sticky geranium[39]	wild geranium
Gevin	*nervosum* (Rydb.) C. L. Hitchc.		
	= *G. nervosum* Rydb.		
	= *G. strigosum* Rydb.		
GEUM	***Geum***	**avens**	
Geal1	*aleppicum* Jacq.	Allepo avens	
	= *G. strictum* Ait.		
Gema	*macrophyllum* Willd.	largeleaf avens	
	= *G. oregonense* Rydb.		
Gemap	*perincisum* (Rydb.) Raup		
	= *Geum perincisum* Rydb.		
Gero1	*rossii* (R. Br.) Ser.	golden avens	
	= *Geum turbinatum* Rydb.		
Getr	*triflorum* Pursh		
	= *G. ciliatum* Pursh		
GILI	***Gilia* = *Ipomopsis*, in part**	**gilia**	
Giac	*achilleaefolia* Benth.	yarrow gilia	
Giag	*aggregata* (Pursh) Spreng.	skyrocket gilia	
	= *Ipomopsis aggregata* (Pursh) V. Grant		
Gica2	*calcarea* M. E. Jones	sticky gilia	
	= *Gilia pinnatifida* Nutt.		
Gica1	*candida* Rydb.		
Gica	*capillaris* Kellogg	hairstem gilia	
Gica3	*capitata* Sims		
Gico	*congesta* Hook.	ballhead gilia	
Gicoc	*congesta*		
	= *G. congesta* var. *burleyana* Const. + Roll.		
Gicof	*frutescens* (Rydb.) Cronq.		
	= *G. frutescens* Rydb.		
	= *G. spergulifolia* Rydb.		
Gila	*laxiflora* (Coult.) Osterh.		
Gilo	*longiflora* (Torr.) G. Don	longflower gilia	
Gimo	*montezumae* Tidest. + Dayt.	Montezuma gilia[40]	
Giri	*rigidula* Benth.		blue gilia
Giria	*acerosa* Gray		
	= *G. acerosa* Britt.		
Gisi	*sinuata* Benth.		shy gilia
Gisp	*spicata* Nutt.	spike gilia	
	= *G. cephaloidea* Rydb.		
GLAU	***Glaux***	**seamilkwort**	
Glma	*maritima* L.		
GLYC1	***Glycyrrhiza***	**licorice**	
Glle	*lepidota* Pursh	American licorice	licorice
GNAP	***Gnaphalium***	**cudweed**	
Gnch	*chilense* Spreng.	cottonbatting cudweed	cottonbatting
Gnex	*exilifolium* A. Nels.		
	= *G. grayi* Nels. + Macbr.		
	= *G. strictum* Gray		
Gnpa	*palustre* Nutt.		
Gnpu	*purpureum* L.	purple cudweed	fragrant cudweed[41]

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[39] Suggested common name.
[40] See also *Collomia, Linanthus,* and *Navarretia*.
[41] Fragrant cudweed is common name for *Gnaphalium obtusifolium*.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Gnul	*uliginosum* L.	low cudweed	
Gnwr	*wrightii* Gray	Wrights cudweed[42]	
GOMP	***Gomphrena***	**globeamaranth**	
Goca	*caespitosa* Torr.		ballclover
Goso	*sonorae* Torr.		lanceleaf globeamara
GONO	***Gonolobus***		**anglepod**
Gopr	*productus* Torr.		milkvine
	= *Vincetoxicum productum* Vail		
GOOD	***Goodyera***	**rattlesnakeplantain**	
Goob	*oblongifolia* Raf.	western rattlesnakeplantain	
	= *G. decipiens* Hubbard		
	= *Epipactis decipiens* Ames		
	= *Peramium decipiens* Piper		
	= *P. menziesii* Morong		
Gore	*repens* (L.) R. Br.	creeping rattlesnakeplantain	
	= *Epipactis repens* Crantz		
	= *Peramium repens* Salisb.		
GRIN	***Grindelia***	**gumweed**	
Grar	*arizonica* Gray		Arizona gumwe
Grars	*stenophylla* Steyermark		
Grde	*decumbens* Greene		
Grpe	*perennis* A. Nels.		
Grsq	*squarrosa* (Pursh) Dunal	curlycup gumweed	
Grsu	*subalpina* Greene		
GYMN	***Gymnocarpium***		**oakfern**
Gydr	*dryopteris* (L.) Newm.		
GYMN1	***Gymnosteris***		
Gypa	*parvula* Heller		
	= *G. nudicaulis* var. *parvula* Jeps.		
HABE	***Habenaria***	**habenaria**	**bogorchid**
Hadi	*dilatata* (Pursh) Hook.	white bogorchid	
	= *Limnorchis dilatata* Rydb.		
	= *L. borealis* Rydb.		
Hahy	*hyperborea* (L.) R. Br.	northern green habenaria	
	= *H. viridiflora* Henry		
	= *Limnorchis hyperborea* Rydb.		
Haob	*obtusata* (Pursh) Richards.		
Haspl	*sparsiflora* Wats.	canyon habenaria	
	= *L. laxiflora* Rydb.		
Havi	*viridis* (L.) R. Br.		
Havib	*bracteata* (Willd.) Gray	satyr habenaria	
	= *H. bracteata* R. Br.		
HACK	***Hackelia***	**stickseed**	
Hafl	*floribunda* (Lehm.) Johnst.		
	= *Lappula floribunda* Greene		
Hale	*leptophylla* (Rydb.) Johnst.		
	= *H. deflexa* (Wahl.) Opiz		
	= *Lappula leptophylla* Rydb.		

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[42] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
HALE	***Halenia***	**spurgentian**	
Hade	*deflexa* (J.E. Sm.) Griseb.	American spurgentian	
	= *Swertia deflexa* J. E. Sm.		
Hare	*recurva* (J. E. Sm.) Allen		spurgentian
	= *H. rothrockii* Gray		
	= *Swertia recurva* J. E. Sm.		
HALO	***Halogeton***	**halogeton**	
Hagl	*glomeratus* (Bieb.) Mey.	barilla	
HAPL	***Haplopappus* = *Aplopappus***	**goldenweed**	
Haac	*acaulis* (Nutt.) Gray	stemless goldenweed	
	= *Stenotus acaulis* Nutt.		
Haacg	*glabratus* D.C. Eat.		
	= *H. glabratus* Blake		
Haacl	*acradenius* (Greene) Blake	paleleaf goldenweed	
Haar	*armerioides* (Nutt.) Gray		
Hacl	*clementis* (Rydb.) Blake		
Hacrl	*croceus* Gray		
	= *Pyrrocoma crocea* Greene		
Hacu	*cuneatus* Gray	wedgeleaf goldenweed	
Hafr	*fremontii* Gray	Fremont goldenweed	
Hagrl	*gracilis* (Nutt.) Gray		
	= *Sideranthus gracilis* A. Nels.		
Hahe	*heterophyllus* (Gray) Blake	jimmyweed	
Hain	*integrifolius* Gray	wholeleaf goldenweed	
	= *Pyrrocoma integrifolia* Greene		
Hala	*laricifolius* Gray	larchleaf goldenweed	
Hama	*macronema* Gray	whitestem goldenweed	
	= *Haplopappus discoideus* Hall + Hall		
Hanu	*nuttallii* T. + G.	Nuttall goldenweed	
	= *Sideranthus grindelioides* Britt.		
Hapa	*parryi* Gray	Parry goldenweed[43]	
Haph	*phyllocephalus* DC.		
Hapha	*annuus* (Rydb.) Hall (ssp.)		
	= *Sideranthus annuus* Rydb.		
Hapy	*pygmaeus* (T. + G.) Gray		
	= *Tonestus pygmaeus* A. Nels.		
Hasp2	*spinulosus* (Pursh) DC.	ironplant goldenweed	
	= *Sideranthus spinulosus* of some manuals		
Haspg	*glaberrimus* (Rydb.) Hall (ssp.)		
Haspt	*turbinellus* (Rydb). Blake		
Hasu	*suffruticosus* (Nutt.) Gray	singlehead goldenweed	
Hate	*tenuisectus* (Greene) Blake	burroweed	
Haun	*uniflorus* (Hook.) T. + G.	plantain goldenweed	
	= *Pyrrocoma uniflora* Greene		
HAPL1	***Haplophyton***	**cockroach-plant**	
Hacr	*crooksii* Benson		
	= *H. cimicidum* of some authors		
HARB	***Harbouria***		
Hatr	*trachypleura* (Gray) C. + R.		

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[43] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
HEDE	***Hedeoma***	**falsepennyroyal**	**mockpennyroyal**
Hedr	*drummondii* Benth.	drummond falsepennyroyal	
HEDY	***Hedysarum***	**sweetvetch**	
Heal	*alpinum* L.		
Heala	*americanum* Michx.		
Hebo	*boreale* Nutt.	northern sweetvetch	
	= *H. carnosulum* Greene		
	= *H. pabulare* A. Nels.		
Heoc	*occidentale* Greene	western sweetvetch	
	= *H. marginatum* Greene		
	= *H. uintahense* A. Nels.		
Hesu1	*sulphurescens* Rydb.	sulfur sweetvetch	
HELE	***Helenium* = *Dugaldia***	**sneezeweed**	
Heam	*amarum* (Raf.) Rock	bitter sneezeweed	
	= *H. tenuifolium* Nutt.		
Heau	*autumnale* L.	common sneezeweed	
	= *H. montanum* Nutt.		
Heho	*hoopesii* Gray	orange sneezeweed	
	= *Dugaldia hoopesii* Rydb.		
HELI2	***Helianthella***	**helianthella**	**wood-sunflower**
Hemi	*microcephala* (Gray) Gray		
Hepa1	*parryi* Gray	Parry helianthella	
Hequ	*quinquenervis* (Hook.) Gray	fivenerve helianthella	
Heun	*uniflora* (Nutt.) T. + G.	oneflower helianthella	
	= *H. multicaulis* D.C. Eat.		
HELI1	***Helianthus***	**sunflower**	
Hean	*annuus* L.	common sunflower	Kansas sunflowe
	= *H. aridus* Rydb.		
	= *H. lenticularis* Dougl.		
Heci	*ciliaris* DC.		blueweed sunflo
Hela1	*laetiflorus* Pers.	showy sunflower	
Hema	*maximiliani* Schrad.	Maximilian sunflower	
Henu	*nuttallii* T. + G.		
	= *H. fascicularis* Greene		
Hepe	*petiolaris* Nutt.	prairie sunflower	
Hepu	*pumilus* Nutt.		
	= *H. excubitor* E. E. Wats.		
Heri	*rigidus* (Cass.) Desf.	stiff sunflower	
	= *H. subrhomboideus* Rydb.		
HELI4	***Heliopsis***	**heliopsis**	**oxeye**
Hepa	*parvifolia* Gray		oxeye
HELI3	***Heliotropium***	**heliotrope**	
Heco2	*convolvulaceum* (Nutt.) Gray	bindweed heliotrope	bindweed
Hecu	*curassavicum* L.	salt heliotrope	quail-plant
HERA	***Heracleum***	**cowparsnip**	
Hela	*lanatum* Michx.	common cowparsnip	cowparsnip
HETE	***Heterotheca***		**telegraph-plant**
Hesu	*subaxillaris* (Lam.) Britt. + Rusb.		camphor-weed
HEUC	***Heuchera***	**alumroot**	
Hebr	*bracteata* (Torr.) Ser.		
Hecy	*cylindrica* Hook.	roundleaf alumroot	
Heha	*hallii* Gray		
Heni	*nivalis* Rosend.		
Heov	*ovalifolia* Nutt.	ovalleaf alumroot	

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
Hepa2	*parvifolia* T. + G.	littleleaf alumroot	
	= *H. utahensis* Rydb.		
Heril	*richardsonii* R. Br.		
	= *H. hispida* of some authors		
Hesa	*sanguinea* Engelm.	coralbells	
Heve	*versicolor* Greene		painted alumroot
HIER	***Hieracium***	**hawkweed**	
Hial	*albiflorum* Hook.	white hawkweed	
Hica	*canadense* Michx.	Canada hawkweed	
Hife	*fendleri* Schultz. Bip.		
	= *Heteropleura fendleri* Rydb.		
Higr	*gracile* Hook.	slender hawkweed	
HIPP	***Hippuris***	**marestail**	
Hivu	*vulgaris* L.	marestail	
HOFF	***Hoffmanseggia***	**rushpea**	
Hode	*densiflora* Benth.	Indian rushpea	hogpotato
	= *H. glauca* (Ort.) Eifert		
HUMU	***Humulus***	**hop**	**hop**
Hulu	*lupulus* L.	common hop	
	= *H. americanus* Nutt.		
	= *H. neomexicanus* Rydb.		
HYDR	***Hydrophyllum***	**waterleaf**	
Hyca	*capitatum* Benth.	ballhead waterleaf	bluebell waterleaf
Hyfe	*fendleri* (Gray) Heller	Fendler waterleaf	
Hyoc	*occidentale* (Wats.) Gray	western waterleaf	western squawlettuce
HYME2	***Hymenopappus***	**hymenopappus**	**white-ragweed**
Hyfi	*filifolius* Hook.		
Hyfic	*cinereus* (Rydb.) Johnst.		
	= *H. arenosus* Heller		
Hyfie	*eriopodus* B. Turn.		
	= *H. eriopodus* A. Nels.		
Hyfif	*filifolius*		
Hyfil	*lugens* Greene Jeps.		
	= *H. lugens* Greene		
	= *H. macroglottis* Rydb.		
	= *H. scaposus* Rydb.		
Hyfip	*parvulus* (Greene) B. Turn.		
	= *H. parvulus* Greene		
Hyfit	*tomentosus* (Rydb.) B. Turn.		
	= *H. tomentosus* Rydb.		
	= *H. niveus* Rydb.		
Hyfl	*flavescens* Gray		
	= *H. robustus* Greene		
Hyte	*tenuifolius* Pursh		
HYME1	***Hymenoxys* = *Actinea* = *Actinella***	**hymenoxys**	**actinea rubberweed**
Hyac	*acaulis* (Pursh) Parker	stemless hymenoxys	stemless actinea
	= *Actinea acaulis* Spreng.		
Hyaca	*arizonica* (Greene) Parker	Arizona stemless actinea	
	= *Actinea arizonica* A. Nels.		
Hyacc	*caespitosa* (A. Nels.) Parker	woolly stemless actinea	
	= *Actinea integrifolia* Torr.		
	= *Actinella lanata* Nutt.		
Hyaci	*ivesiana* (Greene) Parker		
	= *Actinea leptoclada* var. *invesiana* Macbr.		

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	COMMON NAMES OTHER
Hyar1	*argentea* (Gray) Parker		
	= *Actinea leptoclada* Kuntze		
Hybi	*bigelovii* (Gray) Parker	Bigelow hymenoxys	Bigelow actinea
	= *Actinea bigelovii* Kuntze		
Hybr	*brandegei* (Porter) Parker	Brandegee hymenoxys	Brandegee actin
	= *Actinea brandegei* Kuntze		
Hyco	*cooperi* (Gray) Cockll.		
Hygr	*grandiflora* (T. + G.) Parker	Graylocks hymenoxys	
Hyod	*odorata* DC.	bitterweed hymenoxys	bitterweed actine
	= *Actinea odorata* Kuntze		
Hyri	*richardsonii* (Hook.) Cockll.	pingue, Colorado rubberweed	pingue actinea
	= *Actinea richardsonii* Kuntze		
Hyrif	*floribunda* (Gray) Parker		
	= *Hymenoxys floribunda* Cockll.		
Hyru	*rusbyi* (Gray) Cockll.	hairless bitterweed[44]	
Hysc	*scaposa* (DC.) Parker		
HYOS	***Hyoscyamus***	**henbane**	
Hyni	*niger* L.	black henbane	
HYPE	***Hypericum***	**St.Johnswort**	
Hyan	*anagalloides* C. + S.	trailing St.Johnswort	
Hyfo	*formosum* H.B.K.	southwestern St.Johnswort	
	= *H. scouleri* Hook.		
ILIA	***Iliamna***	**wild hollyhock**	
Ilgr	*grandiflora* (Rydb.) Wiggins		wildhollyhock
	= *Sphaeralcea grandiflora* Rydb.		
Ilri	*rivularis* (Dougl.) Greene	stream globemallow	
	= *Sphaeralcea rivularis* Gray		
IPOM	***Ipomoea*** = ***Quamoclit***	**morningglory**	
Ipco	*coccinea* L.	scarlet starglory	redstar morninggloı
	= *Quamoclit coccinea* Moench		
Iple1	*leptophylla* Torr.	bush morningglory	
Iple	*leptotoma* Torr.		pinktrumpet morningglo
Iplo	*longifolia* Benth.		pinkthroated morninggloı
Ipth	*thurberi* Gray		purple morning
IRES	***Iresine***	**bloodleaf**	
Irhe	*heterophylla* Standl.		
IRIS	***Iris***	**iris**	
Irmi	*missouriensis* Nutt.	RockyMountain iris	flag, fleur-de-lis
ISOE	***Isoetes***	**quillwort**	
Isbo	*bolanderi* Engelm.	Bolander quillwort	
IVA	***Iva***	**sumpweed**	**marsh-elder**
Ivax	*axillaris* Pursh	poverty sumpweed	poverty marsh-e
Ivxa	*xanthifolia* Nutt.	rag sumpweed	rag marsh-elder
IVES	***Ivesia***	**ivesia**	
Ivgo	*gordonii* (Hook.) T. + G.	Gordon ivesia	
	= *Horkelia gordonii* Hook.		
KALL	***Kallstroemia***		
Kagr	*grandiflora* Torr.	caltrop	Arizona-poppy

[44] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
KOCH	***Kochia*** **See also under TREES AND SHRUBS**	**summercypress**	
Koam	*americana* Wats.	greenmolly summercypress	hairy greenmolly
Koamv	*vestita* Wats.		
	= *K. vestita* Rydb.		
Kosc	*scoparia* (L.) Schrad.	Belvedere summercypress	
KRIG	***Krigia***	**dwarfdandelion**	
Krbi	*biflora* (Walt.) Blake		
KUHN	***Kuhnia***	**false boneset**	
Kueu	*eupatorioides* L.		
	= *K. glutinosa* Ell.		
Kueuc	*corymbulosa* T. + G.		
Kule	*leptophylla* Scheele		
Kuro	*rosmarinifolia* Vent.		
LACT	***Lactuca***	**lettuce**	**wild lettuce**
Laca	*canadensis* L.	Canada lettuce	
Lapu	*pulchella* (Pursh) DC.	chicory lettuce	
	= *L. tatarica* ssp. *pulchella* (Pursh) Stebb.		
Lase	*serriola* L.	prickly lettuce	
	= *L. scariola* L.		
Lasei	*integrata* Gren. + Godr.		
	= *L. integrata* A. Nels.		
LAPP	***Lappula***	**stickseed**	
Laec	*echinata* Gilib.	European stickseed	
	= *L. lappula* Karst.		
	= *L. fremontii* Greene		
	= *L. erecta* A. Nels.		
Lare	*redowskii* (Hornem.) Greene		
	= *L. occidentalis* Greene		
	= *L. montana* Greene		
	= *L. calycosa* Rydb.		
Late	*texana* (Scheele) Britt.		
	= *L. cupulata* (Gray) Rydb.		
	= *L. heterosperma* Greene		
LATH	***Lathyrus***	**peavine**	
Laar	*arizonicus* Britt.	Arizona peavine	
Laeu	*eucosmus* Butt. + St. John	bush peavine	
	= *L. decaphyllus* of some manuals		
Lagr	*graminifolius* (Wats.) White	grassleaf peavine	
Lale	*leucanthus* Rydb.	aspen peavine	
	= *L. laetivirens* Greene		
Laoc	*ochroleucus* Hook.	cream peavine	
Lapo	*polymorphus* Nutt.	showy peavine	
	= *L. decaphyllus* Rydb.		
	= *L. incanus* Rydb.		
	= *L. ornatus* Nutt.		
Lave	*venosus* Muhl.	veiny peavine	
LAYI	***Layia***	**tidytips**	
Lagl	*glandulosa* (Hook.) H. + A.	whitedaisy tidytips	
LEON	***Leonurus***	**motherwort**	
Leca	*cardiaca* L.	common motherwort	
LEPI	***Lepidium***		
Lede	*densiflorum* Schrad.	prairie pepperweed	
	= *L. apetalum* of some authors		
Leder	*ramosum* (A. Nels.) Thell.		
	= *L. ramosum* A. Nels.		
Lemo2	*montanum* Nutt.	mountain pepperweed	
	= *L. alyssoides* Gray		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Lemoi	*integrifolium* (Nutt.) C.L. Hitchc.		
	= *L. integrifolium* Nutt.		
Lepe	*perfoliatum* L.	clasping pepperweed	
Lera	*ramosissimum* A. Nels.		
	= *L. divergens* Osterh.		
	= *L. fletcheri* Rydb.		
Levi	*virginicum* L.	Virginia pepperweed	
Levim	*medium* (Greene) C.L. Hitchc.		
	= *L. medium* Greene		
Levip	*pubescens* (Greene) Thell.		
	= *L. hirsutum* Rydb.		
LESQ	***Lesquerella***	**bladderpod**	
Leal	*alpina* (Nutt.) Wats.	alpine bladderpod	
Lealc	*condensata* (A. Nels.) C.L. Hitchc.		
	= *L. parvula* Greene		
Lego	*gordonii* (Gray) Wats.		
Lelu	*ludoviciana* (Nutt.) Wats.	silver bladderpod	
	= *L. argentea* MacM.		
Lemo	*montana* (Gray) Wats.	low bladderpod	
	= *L. curvipes* of some manuals		
LEUC1	***Leucampyx***		
Lene	*newberryi* Gray	wild-cosmos[45]	
LEUC3	***Leucelene***		
Leer	*ericoides* (Torr.) Greene	babywhite aster	
	= *Aster arenosus* (Heller) Blake		
	= *A. leucelene* Blake		
LEUC2	***Leucocrinum***	**starlily**	
Lemo1	*montanum* Nutt.	common starlily	
LEWI	***Lewisia* = *Oreobroma***	**lewisia**	**bitterroot**
Lepy	*pygmaea* (Gray) Robins.	least lewisia	
Lere	*rediviva* Pursh	bitterroot lewisia	
LIAT	***Liatris* = *Lacinaria***	**gayfeather**	
Lili	*ligulistylis* (A. Nels.) K. Schum.	RockyMountain gayfeather	
	= *Lacinaria ligulistylis* A. Nels.		
Lipu	*punctata* Hook.	dotted gayfeather	blazing-star[46]
	= *Lacinaria punctata* Kuntze		
Lipy	*pycnostachya* Michx.	Kansas gayfeather	
LIGU	***Ligusticum***	**ligusticum**	
Lifi	*filicinum* Wats.	fernleaf ligusticum	
Lifit	*tenuifolium* (Wats.) Math. + Const.	slim fernleaf ligusticum	
	= *L. tenuifolium* Wats.		
Lipo	*porteri* C. + R.	Porter ligusticum	loveroot chuch
	= *L. simulans* C. + R.		
	= *L. affine* A. Nels.		
LILI	***Lilium***	**lily**	
Lipa	*parryi* Wats.	Parry lily	lemon lily
Liph	*philadelphicum* L.	western orangecup lily	orangecup lily
	= *L. umbellatum* Pursh		
	= *L. montanum* A. Nels.		
	= *L. andinum* Nutt.		
LIMO	***Limosella***	**mudwort**	
Liaq	*aquatica* L.	water mudwort	

[45] Suggested common name.

[46] Blazing-star is accepted common name for *Mentzelia*.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
LINA3	**_Linanthastrum_ = _Gilia_, in part**	**Nuttall gilia**	
Linu	*nuttallii* (Gray) Ewan = *Gilia nuttallii* Gray = *Leptodactylon nuttallii* Rydb.	Nuttall gilia	
LINA1	**_Linanthus_ = _Gilia_, in part**		
Lian	*androsaceus* (Benth.) Greene = *Gilia androsacea* Steud.	trumpet gilia	
Liau	*aureus* (Nutt.) Greene = *Gilia aurea* Nutt.	yellow gilia	yellow trumpet
Libi	*bigelovii* (Gray) Greene = *Gilia bigelovii* Gray		painted trumpet
Lide	*demissus* (Gray) Greene = *Gilia demissa* Gray		bell trumpet
Lidi	*dichotomus* Benth. = *Gilia dichotoma* Benth.	evening-snow gilia	evening-snow
Liha	*harknessii* (Curran) Greene = *Gilia harknessii* Curran	Harkness gilia	
Lise	*septentrionalis* Mason = *L. harknessii* var. *septentrionalis* Jeps. + Bail.		
LINA2	***Linaria***	**toadflax**	
Lica	*canadensis* (L.) DuMont	oldfield toadflax	bigflower toadflax
Lite1	*texana* Scheele = *L. canadensis* var. *texana* Pennell		
Livu	*vulgaris* Mill. = *L. linaria* Karst	butter-and-eggs toadflax	butter-and-eggs
LINN	***Linnaea***	**twinflower**	
Libo	*borealis* L.		
Liboa	*americana* (Forbes) Rehd. = *L. americana* Forbes	American twinflower	
LINU	***Linum***	**flax**	
Liar	*aristatum* Engelm.		
Liki	*kingii* Wats.		
Lile	*lewisii* Pursh = *L. pratense* Small	Lewis flax	
Liri	*rigidum* Pursh = *Cathartolinum rigidum* Small	stiffstem flax	
Lisu	*sulcatum* Ridd.	grooved flax	
LIST	**_Listera_ = _Ophrys_**	**listera**	
Lico	*convallarioides* (Swartz) Nutt.		twayblade[47]
Lico1	*cordata* (L.) R. Br. = *L. nephrophylla* Rydb.		
LITH1	**_Lithophragma_ = _Tellima_, in part**	**woodlandstar**	
Libu	*bulbifera* Rydb.		
Lipa1	*parviflora* (Hook.) T. + G.	smallflower woodlandstar	
Lite	*tenella* Nutt. = *L. australis* Rydb.	slender woodlandstar	
LITH2	***Lithospermum***	**gromwell**	**stoneseed**
Lica2	*canescens* (Michx.) Lehm.	hoary gromwell	
Lica1	*caroliniense* (Walt.) MacM. = *L. gmelini* Hitchc. = *L. croceum* Fern.	Carolina gromwell	

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[47] Twayblade is the common name for the genus *Liparis*.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Liin	*incisum* Lehm. = *L. angustifolium* Michx. = *L. breviflorum* Engelm. + Gray = *L. linearifolium* Goldie		
Limu	*multiflorum* Gray	manyflower gromwell	
Liru	*ruderale* Lehm. = *L. pilosum* Nutt. = *L. torreyi* Nutt. = *L. lanceolatum* Rydb.	wayside gromwell	
LLOY	***Lloydia***	**alplily**	
Llse	*serotina* (L.) Sweet	common alplily	
LOBE	***Lobelia***	**lobelia**	**lobelia**
Loan	*anatina* Wimm.		bluebell lobelia
Loca	*cardinalis* L.	cardinalflower	
Locag	*graminea* (Lam.) Mc Vaugh (ssp.)		western cardinalflo
Loka	*kalmii* L. = *L. strictiflora* (Rydb.) Lunell		
Losi1	*siphilitica* L.	bigblue lobelia	
Losp	*spicata* Lam.	palespike lobelia	
Losph	*hirtella* Gray = *L. hirtella* Greene		
LOMA	***Lomatium* = *Cogswellia*, in part**	**lomatium**[48]	
Loam	*ambiguum* (Nutt.) *C.* + *R.*	Wyeth biscuitroot	
Loco1	*cous* (Wats.) C. + R. = *L. montanum* C. + R.		
Lodi	*dissectum* (Nutt.) Math. + Const. = *Leptotaenia multifida* Nutt. = *L. eatoni* C. + R.		
Loea	*eastwoodae* (C. + R.) Macbr.		
Logr	*grayi* C. + R.	Gray's lomatium	
Lole	*leptocarpum* (T. + G.) C. + R.	bicolor biscuitroot	
Loma1	*macdougalii* C. + R. = *L. foeniculaceum* var. *macdougalii* (C. + R.) Cronq.	MacDougal lomatium	
Loma2	*macrocarpum* (Nutt.) C. + R.	bigseed lomatium	
Lonu	*nuttallii* (Gray) Macbr.	barestem lomatium	
Loor	*orientale* C. + R.		
Losi	*simplex* (Nutt.) Macbr. = *L. platycarpum* C. + R. = *Cogswellia platycarpa* M. E. Jones	narrowleaf lomatium	
Lotr	*triternatum* (Pursh) C. + R.	nineleaf lomatium	
LOMA1	***Lomatogonium***		
Loro	*rotatum* (L.) Nyman = *Pleurogyne rotata* Griseb.		
LOTU	***Lotus* = *Hosackia***	**deervetch**	**deerclover**
Loco	*corniculatus* L.	birdsfoot deervetch	birdsfoot trefoi
Lopu	*purshianus* (Benth.) Clem. + Clem. = *L. americanus* Bisch.		Spanish-clover
Lori	*rigidus* (Benth.) Greene	shrubby deervetch	desert deervetc
Lowr	*wrightii* (Gray) Greene	Wright deervetch	red-and-yellow
LUPI	***Lupinus***	**lupine**	**wild-pea, blue- blue-bean**
Luam	*ammophilus* Greene	sand lupine	

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[48] Biscuitroot is used for species with bulblike edible corms; lomatium is used for those with taproots.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Luar1	*argenteus* Pursh	silvery lupine	
	= *L. alpestris* A. Nels.		
	= *L. rubricaulis* Greene		
	= *L. spathulatus* Rydb.		
	= *L. tenellus* G. Don		
Luar2	*arizonicus* Wats.	Arizona lupine	
Lubr	*brevicaulis* Wats.	shortstem lupine	
Luca1	*caespitosus* T. + G.	stemless lupine	
	= *L. watsonii* Heller		
	= *L. lepidus* var. *utahensis* C.L. Hitchc.		
	= *L. lepidus* ssp. *caespitosus* Detling		
Luca	*caudatus* Kellogg	tailcup lupine	
	= *L. aduncus* Greene		
	= *L. agentinus* Rydb.		
Luco	*concinnus* Agardh	bajada lupine	
Luev	*evermannii* Rydb.		
Luhi	*hillii* Greene	Hills lupine	
Luki	*kingii* Wats.	Kings lupine	
Lula	*laxiflorus* Lindl.	spur lupine	
Luod	*odoratus* Heller	Mohave lupine	
Lupa2	*palmeri* Wats.	Palmer lupine	
Lupa3	*parviflorus* Nutt.	lodgepole lupine	
Lupl	*plattensis* Wats.	Nebraska lupine	
Lupo	*polyphyllus* Lindl.	Washington lupine	
	= *L. burkei* Wats.		
Lupu	*pusillus* Pursh	rusty lupine	
	= *L. intermontanus* Heller		
Lupur	*rubens* (Rydb.) Dunn (ssp.)	yelloweye lupine	
Luse	*sericeus* Pursh	silky lupine	
	= *L. flexuosus* Agardh		
Lush	*shockleyi* Wats.	desert lupine	
Lusp	*sparisflorus* Benth.	Coulter lupine	
Luwy	*wyethii* Wats.	Wyeth lupine	
	= *L. humicola* A. Nels.		
	= *L. comatus* Rydb.		
LYCH	***Lychnis***	**campion**	
Lyal	*alba* Mill.	evening campion	
Lydr	*drummondii* (Hook.) Wats.	Drummond campion	campion
	= *L. striata* Rydb.		
	= *Silene drummondii* Hook.		
LYCO1	***Lycopodium***	**clubmoss**	
Lyan1	*annotinum* L.	stiff clubmoss	
LYCO	***Lycopus***	**bugleweed**	
Lylu	*lucidus* Turcz.		bugleweed
	= *L. asper* Greene		
LYGO	***Lygodesmia***	**skeletonplant**	
Lygr	*grandiflora* (Nutt.) T. + G.		
Lyju	*juncea* (Pursh) D. Don	rush skeletonplant	
Lysp	*spinosa* Nutt.	thorn skeletonplant	
LYSI1	***Lysimachia* = *Steironema***	**loosestrife**	
Lyci	*ciliata* L.	fringed steironema	fringed loosestrife
	= *Steironema ciliatum* Raf.		
	= *Steironema pumilum* Greene		
MACH	***Machaeranthera* = *Aster*, in part**		
Mabi	*bigelovii* (Gray) Greene	Bigelow aster	
	= *Aster bigelovii* Gray		
Maca1	*canescens* (Pursh) Gray	hoary aster	
	= *Aster canescens* Pursh		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Maci	*cichoriacea* Greene	chicory aster	
	= *Aster cichoriaceus* Blake		
Macol	*coloradoensis* (Gray) Osterh.	Colorado aster	
	= *Aster coloradoensis* Gray		
Magl	*glabriuscula* (Nutt.) Cronq. + Keck	alkali aster	
	= *Aster glabriuscula* Nutt.		
Maglv	*villosa* (Nutt.) Cronq. + Keck		
	= *Aster xylorhiza* T. + G.		
Maru	*rubricaulis* Rydb.		
	= *Aster rubrotinctus* Blake		
Mata	*tanacetifolia* (H.B.K.) Nees	tansyleaf aster	
	= *Aster tanacetifolius* H.B.K.		
Mato	*tortifolia* (Gray) Cronq. + Keck	Mohave aster	
	= *Aster abatus* Blake		
Mave	*venusta* (M.E. Jones) Cronq. + Keck	common woody aster	
	= *Aster venustus* M.E. Jones		
MACR	***Macromeria***		
Mavi	*viridiflora* DC.		marbleseed
Mavit	*thurberi* (Gray) Johnst.		
	= *M. thurberi* Gray		
MADI	***Madia***	**tarweed**	
Magl1	*glomerata* Hook.	cluster tarweed	
MAIA	***Maianthemum***	**beadruby**	
Maca	*canadense* Desf.	Canada beadruby	
	= *Unifolium canadense* Greene		
MALA	***Malacothrix***		
Maco	*coulteri* Harv. + Gray	snakes-head[49]	
Magl2	*glabrata* Gray		desert-dandelion
Maso	*sonchoides* (Nutt.) T. + G.	sowthistle malacothrix[50]	
	= *M. runcinata* A. Nels.		
MALV	***Malva***	**mallow**	
Mane	*neglecta* Wallr.		running mallow
	= *M. rotundifolia* of some authors		
Mapa	*parviflora* L.	little mallow	
Maro	*rotundifolia* L.	running mallow	
MARA	***Marah***	**bigroot**	
Magi	*gilensis* Greene		
MARR	***Marrubium***	**hoarhound**	**horehound**
Mavu	*vulgare* L.	common hoarhound	
MARS	***Marsilea***	**pepperwort**	
Mamu	*mucronata* A. Br.	pepperwort	waterfern
	= *M. vestita* of some authors		
MATR	***Matricaria***	**mayweed**	**false-camomile**
Mama1	*matricarioides* (Less.) Porter	pineappleweed	
	= *Matricaria discoidea* DC.		
MAUR	***Maurandya*** = ***Antirrhinum***	**maurandya**	**false-snapdragon**
Maan	*antirrhiniflora* Willd.		
	= *Antirrhinum maurandioides* Gray		
MEDI	***Medicago***	**medic**	**medick**
Mepo1	*polymorpha* L.	California burclover	bur-clover medic
	= *L. hispida* Gaertn.		
Melu	*lupulina* L.	black medic	black medick
Mesa	*sativa* L.	alfalfa	

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[49] Suggested common name.
[50] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
MELA	***Melampodium***	**blackfoot**	
Mele	*leucanthum* T. + G.	plains blackfoot	
MELI2	***Melilotus***	**sweetclover**	
Meal1	*alba* Desr.	white sweetclover	
Mein	*indica* (L.) All.	annual yellow sweetclover	annual yellow sourclover
Meof	*officinalis* (L.) Lam.	yellow sweetclover	
MENT2	***Mentha***	**mint**	
Mear	*arvensis* L. = *M. arvensis* var. *canadensis* Kuntze = *M. canadensis* L. = *M. borealis* Rydb.	field mint	
Mepi	*piperita* L.	peppermint	
Mespl	*spicata* L.	spearmint	
MENT1	***Mentzelia* = *Nuttallia***	**mentzelia**	**blazingstar stickleaf**
Meal2	*albicaulis* Hook.	whitestem mentzelia	whitestem blazingstar
Mede	*decapetala* (Pursh) Urb. + Gilg	tenpetal mentzelia	tenpetal blazingstar
Mela1	*laciniata* (Rydb.) Darlington		
Mela2	*laevicaulis* (Dougl.) T. + G.		
Memu	*multiflora* (Nutt.) Gray = *M. sinuata* Rydb.	desert mentzelia	
Menu	*nuda* (Pursh) T. + G. = *M. stricta* Stevens	bractless mentzelia	
Mepu	*pumila* (Nutt.) T. + G.		golden blazingstar
Meru	*rusbyi* Woot.		creamy blazingstar
MENY	***Menyanthes***	**bogbean**	
Metr	*trifoliata* L.	common bogbean	
MERT	***Mertensia***	**bluebells**	
Meal3	*alpina* (Torr.) G. Don = *M. tweedyi* Rydb. = *M. obtusiloba* Rydb.		
Meba	*bakeri* Greene = *M. nivalis* Rydb. = *M. lateriflora* Greene	Baker bluebells[51]	
Mebr	*brevistyla* Wats.	shortstyle bluebells	
Meci	*ciliata* (James) G. Don = *M. pallida* Rydb. = *M. picta* Rydb. = *M. polyphylla* Greene = *M. punctata* Greene	mountain bluebells	
Mefr	*franciscana* Heller = *M. pratensis* Heller = *M. alba* Rydb.	Franciscan bluebells	
Mefu	*fusiformis* Greene = *M. papillosa* var. *fusiformis* A. Nels.	spindleroot bluebells	
Mehu	*humilis* Rydb.		
Mela	*lanceolata* (Pursh) A. DC. = *M. linearis* Greene = *M. papillosa* Greene	lanceleaf bluebells	

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[51] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Meob	*oblongifolia* (Nutt.) G. Don	oblongleaf bluebells	
	= *M. nevadensis* A. Nels.		
	= *M. coronata* A. Nels.		
	= *M. intermedia* Rydb.		
	= *M. foliosa* A. Nels.		
	= *M. tubiflora* Rydb.		
	= *M. nutans* Howell		
	= *M. praecox* Macbr.		
Meor	*oreophila* Williams		
Mepa	*paniculata* (Ait.) G. Don	panicle bluebells	
Mevi	*viridis* A. Nels.	greenleaf bluebells	
	= *M. ovata* Rydb.		
	= *M. perplexa* Rydb.		
	= *M. lineariloba* Rydb.		
	= *M. parryi* Rydb.		
MICR1	***Microseris***	**microseris**	
Micu	*cuspidata* (Pursh) Schultz-Bip.		
	= *Nothocalais cuspidata* Greene		
Minu	*nutans* (Geyer) Schultz-Bip.	nodding microseris	
MICR2	***Microsteris***		
Migr	*gracilis* (Hook.) Greene		
Migrh	*humilior* (Hook.) Cronq.		
	= *M. humilis* Greene		
	= *M. gracilis* ssp. *humilis* V. Grant		
MILL	***Milla***	**Mexicanstar**	
Mibi1	*biflora* Cav.	Mexicanstar	
MIMU	***Mimulus***	**monkeyflower**	
Mica	*cardinalis* Dougl.	crimson monkeyflower	
Mifl	*floribundus* Dougl.		
	= *M. membranaceus* A. Nels.		
Migu	*guttatus* DC.	common monkeyflower	yellow monkeyflow
	= *M. hallii* Greene		
	= *M. langsdorfii* Donn		
	= *M. puberulus* Gand.		
Mile	*lewisii* Pursh	Lewis monkeyflower	
Mimo	*moschatus* Dougl.	muskplant monkeyflower	
Mipr	*primuloides* Benth.	primrose monkeyflower	
Miru	*rubellus* Gray		
	= *M. gratioloides* Rydb.		
Miti	*tilingii* Regel		
	= *M. alpinus* Piper		
	= *M. caespitosus* Greene		
	= *M. luteus* var. *alpinus* Gray		
MIRA	***Mirabilis***	**four-o'clock**	
Mibi2	*bigelovii* Gray		weakstem four-o'clock
Mico	*comata* (Small) Standl.		
	= *Allionia comata* Small		
	= *Mirabilis oblongifolia* Heimerl		
Mihi	*hirsuta* (Pursh) MacM.		
	= *Allionia pilosa* Rydb.		
Mili	*linearis* (Pursh) Heimerl		
	= *Allionia linearis* Pursh		
	= *Oxybaphus linearis* Robins.		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Milid	*decipiens* (Standl.) Kearney		
	= *M. decipiens* Standl.		
Milo	*longiflora* L.	sweet four-o'clock	longneck four-o'clock
Milow	*wrightiana* (Gray) K. + P.		
	= *H. wrightiana* Gray		
Mimu	*multiflora* (Torr.) Gray	Colorado four-o'clock	wild four-o'clock
	= *Quamoclidion multiflorum* Torr.		
Miny	*nyctaginea* (Michx.) MacM.		
MITE	***Mitella***	**miterwort**	
Mica1	*caulescens* Nutt.		
Mipe	*pentandra* Hook.	fivestamen miterwort	
Mist	*stenopetala* Piper	smallflower miterwort	
	= *M. parryi* A. Nels.		
MOLD	***Moldavica***	**false-dragonhead**	**dragonhead**
Mopa	*parviflora* (Nutt.) Britt.	American false-dragonhead	
	= *Dracocephalum parviflorum* Nutt.		
MOLL	***Mollugo***	**carpetweed**	**Indian-chickweed**
Move	*verticillata* L.	carpetweed	
MONA	***Monarda***	**beebalm**	**horsemint**
Mofi	*fistulosa* L.	wildbergamot beebalm	
	= *M. mollis* L.		
Mome	*menthaefolia* Grah.	mintleaf beebalm	
	= *M. fistulosa* var. *menthaefolia* Fern.		
Mope2	*pectinata* Nutt.	pony beebalm	
MONE	***Moneses***		
Moun1	*uniflora* (L.) Gray	woodnymph	
MONO1	***Monolepis***	**monolepis**	
Monu	*nuttalliana* (Schult.) Greene	Nuttall monolepis	patata, patota
MONO2	***Monotropa***	**Indianpipe**	
Mohy	*hypopitys* L.	Indianpipe	pinesap
Mohyl	*latisquama* (Rydb.) K. + P.		
	= *Hypopitys latisquama* Rydb.		
Moun	*uniflora* L.	Indianpipe	
MONT	***Montia* = *Claytonia*, in part**	**Indianlettuce**	
Moch	*chamissoi* (Ledeb.) Dur. + Jacks.	water Indianlettuce	water springbeauty
Mope1	*perfoliata* (Donn) Howell	minerslettuce	
	= *Claytonia perfoliata* Donn		
	= *Limnia depressa* Rydb.		
	= *Limnia humifusa* Rydb.		
MUSI	***Musineon***		
Mudi	*divaricatum* (Pursh) Nutt.		
	= *M. pedunculatum* A. Nels.		
Mudih	*hookeri* T. + G.		
	= *M. hookeri* (T. + G.) Nutt.		
Mute	*tenuifolium* Nutt.		
MYOS2	***Myosotis***	**forgetmenot**	
Mysy	*sylvatica* Hoffm.	woodland forgetmenot	
Mysya	*alpestris* (Schmidt) Koch		
	= *M. alpestris* Schmidt.		

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	COMMON NAMES OTHER
MYOS1	***Myosurus***	**mousetail**	
Myar	*aristatus* Benth.		
Mymi	*minimus* L.	tiny mousetail	
NAJA	***Najas* = *Naias***	**naiad**	
Nama	*marina* L.	spiny naiad	
NAVA	***Navarretia* = *Gilia*, in part**		
Nabr	*breweri* (Gray) Greene = *Gilia breweri* Gray	Brewer gilia	
Nain	*intertexta* (Benth.) Hook. = *Gilia intertexta* Steud.	woolly navarretia[52]	woolly gilia
NEMO	***Nemophila***	**nemophila**	
Nebr	*breviflora* Gray	Great Basin nemophila	
NEPE	***Nepeta***	**nepeta**	
Neca	*cataria* L.	catnip	
NICO	***Nicotiana*** **See also under TREES AND SHRUBS**	**tobacco**	
Niat	*attenuata* Wats.	coyote tobacco	
Nitr	*trigonophylla* Dunal	desert tobacco	
NOTH2	***Notholaena***	**cloakfern**	
Nofe	*fendleri* Kunze	zigzag cloakfern	
NUPH	***Nuphar***	**cowlily**	
Nupo	*polysepalum* Engelm. = *nymphaea polysepala* Greene	RockyMountain cowlily	
OENO	***Oenothera***	**eveningprimrose**	
Oebi	*biennis* L.	common eveningprimrose	
Oebr	*brevipes* Gray	golden eveningprimrose	
Oeca1	*caespitosa* Nutt.	tufted eveningprimrose	
Oecac	*crinita* (Rydb.) Munz = *Pachylophus crinitus* Rydb.		
Oecam	*montana* (Nutt.) Durand		
Oeca2	*cardiophylla* Torr.	heartleaf eveningprimrose	
Oecl	*clavaeformis* Torr. + Frem.	browneyed eveningprimrose	
Oeco	*coronopifolia* T. + G.		
Oefl	*flava* (A. Nels.) Garrett	yellow eveningprimrose	
Oehe	*heterantha* Nutt.		
Oeho	*hookeri* T. + G.	Hooker eveningprimrose	
Oela1	*laciniata* Hill	cutleaf eveningprimrose	
Oela3	*latifolia* (Rydb.) Munz = *Anogra cinerea* Rydb.		
Oela2	*lavendulaefolia* T. + G.	lavenderleaf eveningprimrose	
Oepa	*pallida* Lindl.	pale eveningprimrose	
Oero	*rosea* Ait.	rose sundrops	
Oeru	*runcinata* (Engelm.) Munz = *O. pallida* ssp. *runcinata* (Engelm.) Munz + Klein	runcinate eveningprimrose	

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[52] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Oest	*strigosa* (Rydb.) Mack. and Bush = *O. rydbergii* House = *O. biennis* var. *strigosa* Piper		
Oeta	*taraxacoides* (Woot. + Standl.) Munz = *Lavauxia taraxacoides* Woot. + Standl.		dandelion sundrops
Oetr1	*trichocalyx* Nutt. = *Anogra rhizomata* A. Nels. = *Anogra violacea* A. Nels.		
Oetr2	*triloba* Nutt.		
ONOS	***Onosmodium***	**marbleseed**	
Onmo	*molle* Michx.	western marbleseed	
Onmoo	*occidentale* (Mack.) Johnst. = *O. occidentale* Mack.		
OPHI	***Ophioglossum***	**adderstongue**	
OREO	***Oreoxis***	**oreoxis**	
Oral	*alpina* (Gray) C. + R. = *Cymopterus alpinus* Gray	alpine oreoxis	
Orba	*bakeri* C. + R. = *Cymopterus bakeri* M. E. Jones		
Orhu	*humilis* Raf. = *Cymopterus humilis* Tidest. + Kitt.		
OROB	***Orobanche***	**broomrape**	**cancerroot**
Orun	*uniflora* L. = *Thalesia sedi* Rydb.	ghostpipe	
OROG	***Orogenia***		
Orli	*linearifolia* Wats.	Indianpotato	
ORTH	***Orthocarpus***	**owlclover**	
Orlu	*luteus* Nutt.	yellow owlclover	
Orpu1	*purpurascens* Benth.	escobita owlcover	
Orpu2	*purpureo-albus* Gray	purplewhite owlclover	
Orto	*tolmiei* H. + A.	Tolmie owlclover	
OSMO	***Osmorhiza***	**sweetroot**	
Osch	*chilensis* H. + A. = *O. divaricata* Nutt. = *O. nuda* Torr.	spreading sweetroot	
Osde	*depauperata* Phil. = *O. obtusa* Fern.	bluntseed sweetroot	
Osoc	*occidentalis* (Nutt.) Torr.	sweetanise	
OXAL	***Oxalis***	**oxalis**	**woodsorrel, sheepsour**
Oxst	*stricta* L.	common yellow oxalis	
Oxvi1	*violacea* L.	violet woodsorrel oxalis	
OXYP	***Oxypolis***	**cowbane**	
Oxfe	*fendleri* (Gray) Heller	Fendler cowbane	cowbane
OXYR	***Oxyria***	**mountainsorrel**	
Oxdi	*digyna* (L.) Hill	alpine mountainsorrel	mountainsorrel
OXYT	***Oxytropis = Aragallus***	**crazyweed**	**white loco**
Oxca	*campestris* (L.) DC.		
Oxcag	*gracilis* (A. Nels.) Barneby = *O. villosa* K. Schum.		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Oxde	*deflexa* (Pall.) DC. = *O. retrorsa* Fern.	dropped crazyweed	
Oxla1	*lagopus* Nutt. = *O. argentata* Pursh = *A. blankinshipii* A. Nels.	haresfoot crazyweed	
Oxla	*lambertii* Pursh = *Spiesia lambertii* Kuntze	Lambert crazyweed	
Oxmu	*multiceps* Nutt. = *O. minor* Cockll.		
Oxor	*oreophila* Gray		silver crazywee
Oxpa	*parryi* Gray		
Oxse	*sericea* Nutt. = *O. lambertii* var. *ochroleuca* A. Nels.	silky crazyweed	
Oxses	*spicata* (Hook.) Barneby = *O. spicata* Pammell		
Oxsp2	*splendens* Hook. = *O. richardsonii* Woot. + Standl.	showy crazyweed	
Oxvi2	*viscida* Nutt. = *O. viscidula* Tidest.		
PALA	***Palafoxia* = *Othake***	**palafoxia**	
Paca1	*callosa* (Nutt.) T. + G.		
Pali	*linearis* (Cav.) Lag.	desert palafoxia	
Palig	*gigantea* M.E. Jones = *P. linearis* var. *arenicola* A. Nels.		
Pasp	*sphacelata* (Nutt.) Cory		
PANA	***Panax***	**ginseng**	
PARI	***Parietaria***	**pellitory**	
Pape1	*pensylvanica* Willd.	Pennsylvania pellitory	
PARN	***Parnassia***	**parnassia**	
Pafi	*fimbriata* Konig	RockyMountain parnassia	
Papa1	*palustris* L.	wideworld parnassia	
Papa	*parviflora* DC.	smallflower parnassia	grass-of-parna
PARO	***Paronychia***	**nailwort**	**whitlowwort**
Pade	*depressa* T. + G. = *P. diffusa* A. Nels.		
Paja	*jamesii* T. + G. = *P. wardii* Rydb.	James nailwort	nailwort
Papu	*pulvinata* Gray	RockyMountain nailwort	
PAST	***Pastinaca***		
Pasa	*sativa* L.	garden parsnip	parsnip
PECT1	***Pectis***	**pectis**	**fetidmarigold**
Pefi	*filipes* Gray	threadstem pectis	threadstem fetidmarig
Pepa1	*papposa* Gray		chinchweed
PECT2	***Pectocarya***	**combseed**	**combseed**
PEDI	***Pedicularis***	**pedicularis**	**woodbetony, fernleaf**
Pebr1	*bracteosa* Benth. = *P. paysoniana* Pennell	bracted pedicularis	
Peca4	*canadensis* L.	early pedicularis	

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Pecol	*contorta* Benth.		
	= *P. lunata* Rydb.		
Pecoc	*ctenophora* (Rydb.) Nels. + Macbr.		
	= *P. ctenophora* Rydb.		
Pecr1	*crenulata* Benth.	meadow pedicularis	
Pecy1	*cystopteridifolia* Rydb.		
Pegr5	*grayi* A. Nels.	Grays pedicularis	
	= *P. procera* Gray		
Pegr1	*groenlandica* Retz.	elephanthead pedicularis	elephanthead
	= *Elephantella groenlandica* Rydb.		
Pepa4	*parryi* Gray	Parry lousewort	
Pera3	*racemosa* Hook.	sickletop pedicularis	
Pesc	*scopulorum* Gray		
	= *P. sudetica* var. *scopulorum* Gray		
PELL	***Pellaea***	**cliffbrake**	
Peat	*atropurpurea* (L.) Link	purple cliffbrake	
PENS	***Penstemon*** **See also under TREES AND SHRUBS**	**penstemon**	**beard tongue**
Peab	*abietinus* Pennell	firleaf penstemon	
Peac	*acuminatus* Lindl.	sharpleaf penstemon	
Peal1	*albidus* Nutt.	white penstemon	
Peal	*alpinus* Torr.	alpine penstemon	
	= *P. riparius* A. Nels.		
	= *P. glaber* var. *alpinus* Gray		
Peam	*ambiguus* Torr.	gilia penstemon	
Pean1	*angustifolius* Nutt.	narrowleaf penstemon	
	= *P. caeruleus* Nutt.		
Pear	*arenicola* A. Nels.	sand penstemon	
Peat1	*attenuatus* Lindl.		
Peatp	*pseudoprocerus* (Rydb.) Cronq.		
	= *P. pseudoprocerus* Rydb.		
Peba	*barbatus* (Cav.) Roth	beardlip penstemon	
Pebr	*bridgesii* Gray	Bridges penstemon	
Peca2	*caespitosus* Nutt.	mat penstemon	
Peco	*comarrhenus* Gray	dusty penstemon	
Pecr	*crandallii* A. Nels.	Crandall penstemon	
Pecrg	*glabrescens* (Pennell) Keck (ssp.)		
	= *P. glabrescens* Pennell		
Pecy2	*cyananthus* Hook.	Wasatch penstemon	
Pecy3	*cyanocaulis* Pays.		
Pecy	*cyathophorus* Rydb.	Northpark penstemon	
Pede	*deustus* Lindl.	scabland penstemon	
Peer	*eriantherus* Pursh	fuzzytongue penstemon	
	= *P. cristatus* Nutt.		
	= *P. saliens* Rydb.		
Pegl	*glaber* Pursh	sawsepal penstemon	
	= *P. gordonii* Hook.		
	= *P. erianthus* Pursh		
Pegr3	*gracilis* Nutt.	slender penstemon	
	= *P. digitalis* var. *gracilis* Trautv.		
	= *P. pubescens* var. *gracilis* Trautv.		
Pegr4	*grandiflorus* Nutt.	shell-leaf penstemon	
	= *P. bradburii* Pursh		

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
Peha1	*hallii* Gray	Halls penstemon	
Peha	*harbourii* Gray	Harbours penstemon	
	= *P. bakeri* Greene		
Pehu	*humilis* Nutt.	low penstemon	
	= *P. collinus* A. Nels.		
	= *P. brevis* A. Nels.		
Pela	*laevis* Pennell		
Pela1	*laricifolius* H. + A.	larchleaf penstemon	
Pelae	*exilifolius* (A. Nels.) Keck (ssp.)	Nelson larchleaf penstemon	
	= *P. exilifolius* A. Nels.		
	= *P. laricifolius* var. *exilifolius* Pays.		
Peli	*linarioides* Gray	toadflax penstemon	
Pelic	*coloradoensis* (A. Nels.) Keck (ssp.)	Colorado penstemon	
	= *P. coloradoensis* A. Nels.		
Peme	*mensarum* Pennell	Grandmesa penstemon	
Pemo	*montanus* Greene	cordroot penstemon	
Peni	*nitidus* Benth.	waxleaf penstemon	
Pepa2	*pachyphyllus* Gray	thickleaf penstemon	
Pepr	*procerus* Grah.	littleflower penstemon	
	= *P. micranthus* Nutt.		
Peps	*pseudospectabilis* M.E. Jones	desert penstemon	
Pera1	*radicosus* A. Nels.	matroot penstemon	
	= *P. lineolatus* Greene		
Pere	*retrorsus* Pennell		
Pery	*rydbergii* A. Nels.	Rydberg penstemon	
Pese	*secundiflorus* Benth.	sidebells penstemon	
	= *P. versicolor* Pennell		
Pest	*strictus* Benth.	RockyMountain penstemon	
Pests	*strictiformis* (Rydb.) Keck (ssp.)	Mancos penstemon	
Pesu3	*subglaber* Rydb.		
	= *P. utahensis* A. Nels.		
Pesu1	*subulatus* M.E. Jones	scarlettube penstemon[53]	
Pesu2	*superbus* A. Nels.	SantaRita penstemon	
Pete	*teucrioides* Greene	Germander penstemon	
Peun	*unilateralis* Rydb.	oneside penstemon	
	= *P. secundiflorus* Gray		
Peut	*utahensis* Eastw.	Utah penstemon	
Pevi1	*virens* Pennell	green penstemon	
Pevi	*virgatus* Gray	wandbloom penstemon	
Pewa	*watsonii* Gray	Watson penstemon	
	= *P. phlogifolius* Greene		
	= *P. fremontii* var. *parryi* Gray		
Pewh	*whippleanus* Gray	Whipple penstemon	
	= *P. glaucus* var. *stenosepalus* Gray		
	= *P. stenosepalus* Howell		
PERE	***Perezia***	**perezia**	
Pena	*nana* Gray		desert holly
PERI	***Pericome***	**pericome**	
Peca5	*caudata* Gray	tailleaf pericome	
PERI1	***Perideridia***		
Pega	*gairdneri* (H. + A.) Math.	yampa	wildcaraway
	= *Carum gairdneri* Gray		
	= *Atenia gairdneri* H. + A.		

[53] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
PETA	***Petalostemon* = *Petalostemum***	**prairieclover**	
Peca1	*candidum* Michx.	white prairieclover	
Pecao	*oligophyllus* (Torr.) Hermann	slender white prairieclover	
	= *Petalostemon gracilis* var. *oligophyllus* Torr.		
	= *Petalostemon oligophyllus* Rydb.		
Peco2	*compactus* (Spreng.) Swezey		
Pefl	*flavescens* Wats.	yellow prairieclover	
Pepu	*purpureum* (Vent.) Rydb.	purple prairieclover	
	= *Dalea purpurea* Vent.		
	= *Kuhnistera purpurea* MacM.		
	= *P. violaceum* Michx.		
	= *P. mollis* Rydb.		
Pepup	*pubescens* (A. Nels.) Harrington		
	= *P. pubescens* A. Nels.		
Pevi2	*villosum* Nutt.	silky prairieclover	
PETA1	***Petasites***	**butterbur**	
Pesa	*sagittata* (Pursh) Gray		
PETU	***Petunia***	**petunia**	
Pepa3	*parviflora* Juss.	mat petunia[54]	
PHAC	***Phacelia***	**phacelia**	**caterpillarweed**
Phca2	*campanularia* Gray	harebell phacelia	
Phcr	*crenulata* Torr.		
Phgl1	*glandulosa* Nutt.	glandular phacelia	
	= *P. bakeri* (Brand) Macbr.		
Phha	*hastata* Lehm.		
Phhe	*heterophylla* Pursh		
	= *P. biennis* A. Nels.		
Phid	*idahoensis* Henders.	Idaho phacelia	
	= *P. ciliosa* Rydb.		
Phli1	*linearis* (Pursh) Holz.	threadleaf phacelia	
Phmi1	*minor* (Harv.) Thell.	bluebell phacelia	California bluebell
Phne1	*neomexicana* Torr.		
	= *P. alba* Rydb.		
Phra	*ramosissima* Lehm.	branching phacelia	
Phse	*sericea* (Grah.) Gray	silky phacelia	
Phta	*tanacetifolia* Benth.	tansy phacelia	
PHAS	***Phaseolus***	**bean**	
Phac	*acutifolius* Gray	Texas bean	tepary bean
Phacl	*latifolius* Freeman	tepary bean	
Phan	*angustissimus* Gray	slimleaf bean	
Phme	*metcalfei* Woot. + Standl.	Metcalfe bean	
PHLO	***Phlox***	**phlox**	
Phal1	*alyssifolia* Greene		
	= *P. collina* Rydb.		
Pham1	*amabilis* Brand		
Phau	*austromontana* Cov.	desert phlox	
Phca3	*caespitosa* Nutt.	tufted phlox	
	= *P. douglasii* Hook.		
Phdi	*diffusa* Benth.	spreading phlox	
Phho	*hoodii* Richards.	Hoods phlox	
Phhoc	*canescens* (T. + G.) Peck		
	= *P. canescens* T. + G.		
Phhog	*glabrata* E. Nels.		
	= *P. glabrata* Brand		

[54] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Phke	*kelseyi* Britt.	Kelsey phlox	
Phlo	*longifolia* Nutt.	longleaf phlox	
	= *P. puberula* A. Nels.		
	= *P. linearifolia* Gray		
	= *P. cernua* E. Nels.		
Phmu	*multiflora* A. Nels.	flowery phlox	
	= *P. patula* A. Nels.		
Phmuc	*costata* (Rydb.) Wherry (ssp.)		
	= *P. costata* Rydb.		
Phmud	*depressa* (E. Nels.) Wherry (ssp.)	dwarf flowery phlox	
	= *P. depressa* Rydb.		
Phmu1	*muscoides* Nutt.		
	= *P. bryoides* Nutt.		
	= *P. hoodii* ssp. *muscoides* Wherry		
Phna	*nana* Nutt.	SantaFe phlox	
Phpi	*pilosa* L.	downy phlox	
Phst	*stansburyi* (Torr.) Heller	Stansbury phlox	
PHOL	***Pholistoma***		
Phau1	*auritum* (Lindl.) Lilja	purple nemophila	tomatoweed
	= *Nemophila aurita* Lindl.		
PHYL1	***Phyla = Lippia***		
Phcu	*cuneifolia* (Torr.) Greene		
Phla1	*lanceolata* (Michx.) Greene		
PHYS	***Physalis***	**groundcherry**	
Phfe	*fendleri* Gray	Fendler groundcherry[55]	
Phhe1	*heterophylla* Nees	clammy groundcherry	
Phla	*lanceolata* Michx.		
	= *P. polyphylla* Greene		
Phlo2	*lobata* Torr.		
Phlo1	*longifolia* Nutt.		
Phpu	*pubescens* L.	downy groundcherry	
PHYS1	***Physaria***	**twinpod**	
Phac1	*acutifolia* Rydb.	twinpod	
Phau2	*australis* (Pays.) Rollins		
	= *P. didymocarpa* var. *australis* Pays.		
Phne2	*newberryi* Gray		
PHYT	***Phytolacca***		
Pham	*americana* L.	common pokeberry	
PITY	***Pityrogramma***	**goldfern**	
Pitr	*triangularis* (Kaulf.) Maxon		
PLAG	***Plagiobothrys = Allocarya***	**popcornflower**	**bloodweed**
Plle	*leptocladus* (Greene) Johnst.		
	= *P. orthocarpus* Johnst.		
Plsc	*scouleri* (H. + A.) Johnst.		
	= *P. cognatus* Johnst.		
	= *P. scopulorum* Johnst.		
PLAN1	***Plantago***	**plantain--perennial species, Indianwheat --annual species**	
Plar	*argyrea* Morris		
Pler	*eriopoda* Torr.	redwool plantain	
Plin	*insularis* Eastw.	desert Indianwheat	
Plinf	*fastigiata* (Morris) Jeps.	desert Indianwheat	
	= *P. fastigiata* Morris		

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[55] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Plla	*lanceolata* L.	buckhorn plantain	
Plma	*major* L.	rippleseed plantain	
Plpa	*patagonica* Jacq.	Patagonia Indianwheat	
	= *P. purshii* R. + S.		
	= *P. spinulosa* Dcne.		
Plrh	*rhodosperma* Dcne.	redseed plantain	
Pltw	*tweedyi* Gray	Tweedy plantain	
Plvi	*virginica* L.	paleseed plantain	
PLAT1	***Platystemon***	**platystemon**	
Plca1	*californicus* Benth.	creamcups platystemon	creamcups
PLUC	***Pluchea*** **See also under TREES AND SHRUBS**	**pluchea**	
Plca2	*camphorata* (L.) DC.	camphor pluchea	saltmarsh-fleabane
PODI	***Podistera***		
Poea	*eastwoodae* (C. + R.) Math. + Const.		
	= *Ligusticella eastwoodae* C. + R.		
POLA	***Polanisia***	**clammyweed**	
Podo	*dodecandra* (L.) DC.		
Podot	*trachysperma* (T. + G.) Iltis (ssp.)	roughseed clammyweed	clammyweed
POLE	***Polemonium***	**polemonium**	**Jacobs-ladder**
Pofi	*filicinum* Greene	fernleaf polemonium	fernleaf Jacobs-ladder
Pofl	*flavum* Greene	yellow polemonium	yellow Jacobs-ladder
Pofo	*foliosissimum* Gray	leafy polemonium	
	= *P. robustum* Rydb.		
Pooc1	*occidentale* Greene	western polemonium	
Popu1	*pulcherrimum* Hook.	skunkleaf polemonium	
Popud	*delicatum* (Rydb.) Cronq.		
	= *P. delicatum* Rydb.		
Povi	*viscosum* Nutt.	sticky polemonium	sticky Jacobs-ladder
	= *P. confertum* Gray		
POLY2	***Polygala***	**polygala**	**milkwort**
Poac2	*acanthoclada* Gray	thorn polygala	thorn milkwort
Poal	*alba* Nutt.	white polygala	white milkwort
Poru1	*rusbyi* Greene		
Posu	*subspinosa* Wats.	spiny polygala	spiny milkwort
POLY5	***Polygonatum***	**Solomonseal**	
Poco4	*cobrense* (Woot. + Standl.) Gates		Solomonseal
POLY3	***Polygonum***	**knotweed**	
Poam2	*amphibium* L.	water ladysthumb	
	= *P. hartwrightii* Gray		
Poav	*aviculare* L.	prostrate knotweed, box knotweed	
	= *P. buxiforme* Small		
Pobi3	*bistortoides* Pursh	American bistort	
Poco5	*coccineum* Muhl.		
	= *P. emersum* Britt.		
	= *Persicaria coccinea* Greene		
Poco3	*convolvulus* L.	dullseed cornbind	cornbind
Podo1	*douglasii* Greene	Douglas knotweed	
	= *P. montanum* Greene		
Poer	*erectum* L.	erect knotweed	

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Pohy	*hydropiperoides* Michx.		
Pola	*lapathifolium* L.	curlytop ladysthumb	
Poke	*kelloggii* Greene	Kellogg knotweed	
	= *P. minutissimum* Williams		
Pope1	*persicaria* L.	spotted ladysthumb	smartweed
Popo	*polygaloides* Meisn.	polygala knotweed	
Pora	*ramosissimum* Michx.	bushy knotweed	
	= *P. prolificum* Robins.		
Posa2	*sawatchense* Small	sawatch knotweed	
Posp	*spergulariaeforme* Small		
Povi2	*viviparum* L.	viviparous bistort	
	= *Bistorta vivipara* S.F. Gray		
Powa	*watsonii* Small		
POLY4	***Polystichum***	**hollyfern**	
Polo1	*lonchitis* (L.) Roth	mountain hollyfern	
PORO	***Porophyllum***	**poreleaf**	
Pogr	*gracile* Benth.	slender poreleaf	yerbadelvenado
PORT	***Portulaca***	**portulaca**	
Pool	*oleracea* L.	common purslane	purslane, pursl
POTA	***Potamogeton***	**pondweed**	
POTE	***Potentilla*** **See also under TREES AND SHRUBS**	**cinquefoil**	
Poam1	*ambigens* Greene		
Poan2	*anserina* L.	silverweed cinquefoil	
	= *Argentina anserina* Rydb.		
Poar3	*arguta* Pursh		
	= *Drymocallis arguta* Rydb.		
Poarc	*convallaria* (Rydb.) Th. Wolf		
	= *Drymocallis convallaria* Rydb.		
Pobi2	*biennis* Greene	biennial cinquefoil	
Pobr	*brunnescens* Rydb.		
Poco2	*concinna* Richards.	elegant cinquefoil	
	= *P. bicrenata* Rydb.		
Podi	*diversifolia* Lehm.	varileaf cinquefoil	
	= *P. glaucophylla* Lehm.		
Pofi1	*fissa* Nutt.	bigflower cinquefoil	
Pofl1	*flabellifolia* T. + G.	fanleaf cinquefoil	
Pogl	*glandulosa* Lindl.	gland cinquefoil	
	= *Drymocallis glandulosa* Rydb.		
	= *Drymocallis foliosa* Rydb.		
Pogr2	*gracilis* Hook.	northwest cinquefoil	
	= *P. fastigiata* Nutt.		
	= *P. glomerata* A. Nels.		
	= *P. jucunda* A. Nels.		
	= *P. nuttallii* Lehm.		
	= *P. viridescens* Rydb.		
Pohi	*hippiana* Lehm.	horse cinquefoil	
	= *P. coloradoensis* Rydb.		
	= *P. effusa* Lehm.		
	= *P. filicaulis* (Nutt.) Rydb.		
	= *P. leucophylla* Torr.		
Poni	*nivea* L.		
	= *P. uniflora* Ledeb.		
Pono	*norvegica* L.	Norwegian cinquefoil	
	= *P. monspeliensis* L.		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Pope2	*pensylvanica* L.	Pennsylvania cinquefoil	
	= *P. bipinnatifida* Hook.		
	= *P. strigosa* Tratt.		
Popl	*plattensis* Nutt.	Platte cinquefoil	
	= *P. arizonica* Greene		
Popu	*pulcherrima* Lehm.	beauty cinquefoil	
	= *P. gracilis* var. *pulcherrima* Fern.		
	= *P. filipes* Rydb.		
Poqu	*quinquifolia* Rydb.		
Pori	*rivalis* Nutt.	brook cinquefoil	
PRIM	***Primula***	**primrose**	
Pran	*angustifolia* Torr.	Colorado primrose	
Prin	*incana* M. E. Jones	American primrose	
	= *P. americana* Rydb.		
Prpa2	*parryi* Gray	Parry primrose	
PROB	***Proboscidea* = *Martynia***	**devilsclaws**	
Prlo	*louisianica* (Mill.) Thell.	common devilsclaws	
PRUN1	***Prunella***	**selfheal**	
Prvu	*vulgaris* L.	common selfheal	selfheal
PSEU2	***Pseudocymopterus***	**pseudocymopterus**	
Psmo	*montanus* (Gray) C. + R.		
	= *P. multifidus* Rydb.		
	= *P. purpureus* Rydb.		
	= *P. sylvaticus* A. Nels.		
	= *P. tenuifolius* Rydb.		
	= *P. tidestromii* C. + R.		
	= *P. versicolor* Rydb.		
PSIL	***Psilostrophe***	**paperflower**	
Psco	*cooperi* (Gray) Greene	whitestem paperflower	
Pssp	*sparsiflora* (Gray) A. Nels.	greenstem paperflower	
Psta	*tagetina* (Nutt.) Greene	woolly paperflower	
PSOR	***Psoralea***	**scurfpea**	
Psar	*argophylla* Pursh	silverleaf scurfpea	
Psca	*castorea* Wats.	beaverbread scurfpea	breadroot scurfpea
Psdi	*digitata* Nutt.		
Pses	*esculenta* Pursh	common breadroot scurfpea	
Psla	*lanceolata* Pursh	lemon scurfpea	
	= *P. micrantha* Gray		
Pste	*tenuiflora* Pursh	slimflower scurfpea	slender scurfpea
PTER2	***Pteridium***	**bracken**	
Ptaq	*aquilinum* (L.) Kuhn	bracken	
Ptaql	*latiusculum* (Desv.) Underw.	eastern bracken	
Ptaqp	*pubescens* Underw.	western bracken	
PTER	***Pterospora***	**pinedrops**	
Ptan2	*andromedea* Nutt.	woodland pinedrops	
PTER1	***Pteryxia* Nutt.**		
Ptan	*anisata* (Gray) Math. + Const.		
	= *Aletes anisatus* Theob. + Tseng		
	= *Cymopterus anisatus* Gray		
	= *Pseudocymopterus anisatus* C. + R.		
	= *Pseudopteryxia anisata* Rydb.		

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
PYRO	***Pyrola***	**pyrola**	
Pyas	*asarifolia* Michx.	alpine pyrola	
Pyasp	*purpurea* (Bunge) Fern.		
	= *P. asarifolia* var. *incarnata* Fern.		
	= *P. uliginosa* Torr.		
Pyle	*elliptica* Nutt.	waxflower pyrola	
Pymi	*minor* L.	snowline pyrola	
Pypi	*picta* Smith	whitevein pyrola	
Pyse	*secunda* L.	sidebells pyrola	
Pyvi	*virens* Schweigg.		
	= *P. chlorantha* Swartz		
PYRR	***Pyrrhopappus***		
Pymu	*multicaulis* DC.		false-dandelio
RANU	***Ranunculus***	**buttercup**	**crowfoot**
Raab	*abortivus* L.	littleleaf buttercup	
Raac	*acriformis* Gray	sharp buttercup	
Raad	*adoneus* Gray	alpine buttercup	
Raal	*alismaefolius* Benth.	plantainleaf buttercup	
Raala	*alismellus* Gray		
	= *R. alismellus* Greene		
Raaq	*aquatilis* L.	watercrowfoot buttercup	
Raaqc	*capillaceus* (Thuill.) DC.	hairleaf watercrowfoot	
Raca	*cardiophyllus* Hook.	shore buttercup	
Racy	*cymbalaria* Pursh	shore buttercup	desert butterc
Racys	*saximontanus* Fern.		
	= *Halerpestes cymbalaria* Greene		
Raes	*eschscholtzii* Schlect.		
	= *R. ocreatus* Greene		
Rafl1	*flabellaris* Raf.		
	= *R. delphinifolius* Torr.		
Rafl	*flammula* L.	spearwort buttercup	creeping butte
	= *R. reptans* L.		
	= *R. flammula* var. *reptans* Reich.		
Ragl	*glaberrimus* Hook.	sagebrush buttercup	
Ragm	*gmelinii* DC.		
	= *R. purshii* Richards.		
	= *R. limosus* Nutt.		
Rahy1	*hyperboreus* Rottb.		
Rahy	*hydrocharioides* Gray		small-leaf aqu buttercup
Rain	*inamoenus* Greene		
	= *R. micropetalus* Rydb.		
Raina	*alpeophilus* (A. Nels.) Benson		
	= *R. alpeophilus* A. Nels.		
Rama1	*macauleyi* Gray	Macauley buttercup	
Rama2	*macounii* Britt.		
	= *R. rivularis* Rydb.		
Raoc	*occidentalis* Nutt.	western buttercup	
Raor	*orthorhynchus* Hook.	straightbeak buttercup	
	= *R. macranthus* Brew. + Wats.		
Rape1	*pedatifidus* J. E. Sm.		
Rapea	*affinus* (R. Br.) Benson		
Rape	*pensylvanicus* L. f.	Pennsylvania buttercup	
Rara	*ranunculinus* (Nutt.) Rydb.		
	= *Cyrtorhyncha ranunculinus* Nutt.		

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Rarel	*repens* L.	creeping buttercup	
Rasc	*sceleratus* L. = *R. eremogenes* Greene	blister buttercup	
Rasel	*septentrionalis* Poir.	swamp buttercup	
Raun	*uncinatus* D. Don		
Raune	*earlei* (Greene) Benson = *R. earlei* Greene		
RATI	***Ratibida***	**prairieconeflower**	
Raco	*columnifera* (Nutt.) Woot. + Standl. = *R. columnaris* D. Don	upright prairieconeflower	
Rata	*tagetes* (James) Barnh.		
RHIN	***Rhinanthus***	**rattleweed**	**yellowrattle**
Rhri	*rigidus* Chab. = *R. crista-galli* L.		yellowrattle
RHYN	***Rhynchosia* = *Dolicholus***	**rhynchosia**	**rosarybean**
RIVI	***Rivina***	**rougeplant**	
Rihu	*humilis* L.	bloodberry rougeplant	bloodberry
RORI	***Rorippa* = *Nasturtium* = *Radicula***	**rorippa**	
Rocu	*curvisiliqua* (Hook.) Britt.		
Rocul	*lyrata* (Nutt.) Stuckey = *R. lyrata* Rydb.		
Rona	*nasturtium-aquaticum* (L.) Schinz + Thell. = *Nasturtium officinale* R. Br. = *Radicula nasturtium-aquaticum* Britt. + Rendle	watercress	
Ropa	*palustris* (L.) Besser = *R. islandica* of some manuals		
Rosi	*sinuata* (Nutt.) A. S. Hitchc.	spreading yellowcress	
Rosy	*sylvestris* (L.) Besser	yellow fieldcress	yellowcress
Rote	*teres* (Michx.) Stuckey = *R. obtusa* Britt.		
RUDB	***Rudbeckia***	**coneflower**	
Ruhi	*hirta* L. = *R. serotina* Nutt.	blackeyedsusan	
Rula	*laciniata* L.	cutleaf coneflower	
Rulaa	*ampla* (A. Nels.) Cronq. = *R. ampla* A. Nels.		
Rumo	*montana* Gray	Colorado coneflower[56]	
Ruoc	*occidentalis* Nutt.	western coneflower[57]	
RUME	***Rumex***	**dock**	**sorrel**
Ruac	*acetosella* L.	sheep sorrel	
Ruco	*conglomeratus* Murr.	clustered dock	
Rucr	*crispus* L.	curly dock	
Ruhy	*hymenosepalus* Torr.	canaigre	wild-rhubarb
Ruob	*obtusifolius* L.	bitter dock	
Ruocl	*occidentalis* Wats.	western dock	
Rume	*mexicanus* Meisn.	Mexican dock	
Rupal	*paucifolius* Nutt.	mountain sorrel	
Rusa	*salicifolius* Weinm.		
Rusat	*triangulivalvis* Danser (ssp.) = *R. triangulivalvis* Rech. f.	willow dock	

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[56] Suggested common name.
[57] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Ruut	*utahensis* Rech. f.		
Ruve	*venosus* Pursh	veiny dock	
SAGI2	***Sagina***	**pearlwort**	
Sasa	*saginoides* (L.) Karst.	arctic pearlwort	
SAGI1	***Sagittaria***	**arrowhead**	
Sacu	*cuneata* Sheld.	duckpotato arrowhead	
	= *S. arifolia* J. G. Sm.		
Sala	*latifolia* Willd.	common arrowhead	
SALI1	***Salicornia***	**glasswort**	
Saru	*rubra* A. Nels.	RockyMountain glasswort	
	= *S. europaea* ssp. *rubra* Breitung		
SALS	***Salsola***	**Russianthistle**	
Saka	*kali* L.	common Russianthistle	
	= *S. pestifer* A. Nels.		
Sakat	*tenuifolia* Tausch.	tumbling Russianthistle	
SALV	***Salvia*** **See also under TREES AND SHRUBS**	**sage**	**Arizona sage**
Saar	*arizonica* Gray		
Saco	*columbariae* Benth.	Californica chia	chia sage
Sare	*reflexa* Hornem.		RockyMountai
SAMO	***Samolus***		**waterpimpern**
SANG	***Sanguisorba***	**burnet**	
SANI	***Sanicula***	**sanicle**	
Sama	*marilandica* L.	black sanicle	
SAPO	***Saponaria***	**soapwort**	
Saof	*officinalis* L.	bouncingbet	
SARC1	***Sarcostemma* = *Philibertia* = *Funastrum***		
SART	***Sartwellia***		**gypsumweed**
SAXI	***Saxifraga***	**saxifrage**	
Saar2	*arguta* D. Don	brook saxifrage	
Sabr2	*bronchialis* L.	yellowdot saxifrage	
	= *S. austromontana* Wieg.		
Saca3	*caespitosa* L.		
Sace	*cernua* L.	nodding saxifrage[59]	
	= *S. simulata* Small		
Sach	*chrysantha* Gray	goldbloom saxifrage	
Sade	*debilis* Gray		
Safl2	*flagellaris* Willd.		
Sahi	*hirculus* L.		
Saor	*oregana* Howell	Oregon saxifrage	
Saorm	*montanensis* (Small) C.L. Hitchc.		
Sarh	*rhomboidea* Greene	diamondleaf saxifrage	
	= *S. austrina* A. Nels.		
SCRO	***Scrophularia***	**figwort**	
Scla1	*lanceolata* Pursh	lanceolate figwort	
	= *S. occidentalis* Bickn.		
	= *S. serrata* Rydb.		
SCUT	***Scutellaria***	**scullcap**	
Scan	*angustifolia* Pursh	narrowleaf scullcap	

[58] There are several plants called water-pimpernels, incl. *Veronicaanagallis-aquatica*.
[59] Suggested common name.

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Scbr1	*brittonii* Porter = *S. brittonii* var. *virgulata* Rydb.	Brittons scullcap	
Scga	*galericulata* L.		
Scla	*lateriflora* L.	sideflowering skullcap	Caucasian skullcap
SEDU	***Sedum***	**stonecrop**	
Serh	*rhodanthum* Gray		
Sero	*roseum* (L.) Scop.		
Seroi	*integrifolium* (Raf.) Berger		
Sest	*stenopetalum* Pursh	wormleaf stonecrop	
SELA	***Selaginella***	**selaginella**	
Sede	*densa* Rydb.		
Sedes	*scopulorum* (Maxon) Tryon		
Semu2	*mutica* D.C. Eat.		
SENE	***Senecio* L.**	**groundsel**	
Seam2	*amplectens* Gray	showy alpine groundsel	
Seamh	*holmii* (Greene) Harrington = *S. holmii* Greene	Holmes groundsel	
Seat	*atratus* Greene = *S. milleflorus* Greene	black groundsel	
Sebi	*bigelovii* Gray = *S. chloranthus* Greene	Bigelow groundsel[60]	
Sebih	*hallii* Gray = *S. accedens* Greene		
Seca1	*canus* Hook. = *S. purshianus* Nutt.	woolly groundsel	
Secr1	*crassulus* Gray = *S. semiamplexicaulis* Rydb.	thickleaf groundsel	
Secr2	*crocatus* Rydb. = *S. pyrrhochrous* Greene = *S. longipetiolatus* Rydb.	saffron groundsel	
Secy	*cymbalarioides* Nutt. = *S. laetiflorus* Greene = *S. subcuneatus* Rydb.	cleftleaf groundsel	
Sedi	*dimorphophyllus* Greene		
Seer	*eremophilus* Richards. = *S. ambrosioides* Rydb. = *S. macdougalii* Heller	desert groundsel	
Sefe	*fendleri* Gray	Fendler groundsel	
Sefr	*fremontii* T. + G.	Fremont groundsel	
Sefrb	*blitoides* (Greene) Cronq. = *S. blitoides* Greene = *S. carthamoides* Greene		
Sehy	*hydrophilus* Nutt.	water groundsel	
Sein1	*integerrimus* Nutt.	lambstongue groundsel	
Seini	*integerrimus*		
Seine	*exaltatus* (Nutt.) Cronq. = *S. exaltatus* Nutt. = *S. columbianus* Greene = *S. perplexus* A. Nels.		
Selo	*longilobus* Benth. = *S. filifolius* Nutt. = *S. ridellii* T. + G.	threadleaf groundsel	
Selu1	*lugens* Richards. = *S. glaucescens* Rydb.		
Semu3	*mutabilis* Greene		

[60] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Semu1	*multicapitatus* Greene		
Semu	*multilobatus* T. + G.		
Sene	*neomexicanus* Gray	NewMexico groundsel	
Sepl	*plattensis* Nutt. = *S. balsamitae* Torr.	prairie groundsel	
Seps	*pseudaureus* Rydb.	golden groundsel	
Sepsf	*flavulus* (Greene) Greenm. = *S. flavulus* Greene		
Sera	*rapifolius* Nutt.		
Sesa	*salignus* DC.	willow groundsel	
Sese	*serra* Hook.	butterweed groundsel	
Seso	*soldanella* Gray		
Sesp	*spartioides* T. + G.	broom groundsel	
Seta	*taraxacoides* (Gray) Greene		
Setr	*triangularis* Hook.	arrowleaf groundsel	
Seui	*uintahensis* A. Nels.	Uinta groundsel	
Sevu	*vulgaris* L.	common groundsel	
Sewe	*werneriaefolius* Gray = *S. saxosus* Klatt		
Sewo	*wootonii* Greene		
SIBB	***Sibbaldia* L.**		
Sipr	*procumbens* L.		
SIDA	***Sida***	**sida**	
Sihe	*hederacea* (Dougl.) Gray	alkali sida	
Sisp	*spinosa* L.	prickly sida	
SIDA1	***Sidalcea***	**checkermallow**	
Sica	*candida* Gray	white checkermallow	
Sima	*malvaeflora* Gray	foothill checkermallow	
Sine	*neomexicana* Gray	NewMexican checkermallow	
SILE	***Silene***	**silene**	
Siac	*acaulis* L.	moss silene	
Sian	*antirrhina* L.	sleepy silene	sleepy catchfl
Sila	*laciniata* Cav.	Mexican silene	Mexican cam
Sime	*menziesii* Hook. = *S. stellarioides* Nutt.	Menzies silene	
Sisc	*scouleri* Hook. = *S. hallii* Wats.	Scouler silene	
SISY1	***Sisymbrium***	**garlicmustard**	
Sial	*altissimum* L. = *Norta altissima* Britt.	tumblemustard	
Siel	*elegans* (M. E. Jones) Pays. = *Thelypodium elegans* M.E. Jones		
Sili	*linifolium* Nutt. = *Schoenocrambe decumbens* Rydb. = *S. linifolia* Greene		
Siof	*officinale* (L.) Scop. = *Erysimum officinale* L.		
SISY	***Sisyrinchium***	**blue-eyedgrass**	
Side	*demissum* Greene		blue-eyedgras
Simo	*montanum* Greene	Montana blue-eyedgrass	
Sioc	*occidentale* Bickn.		
SIUM	***Sium***	**waterparsnip**	
Sisu	*suave* Walt. = *S. cicutaefolium* Schrank	hemlock waterparsnip	waterparsnip

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
SMEL	***Smelowskia***		
Smca	*calycina* (Steph.) C. A. Mey.		
	= *S. americana* Rydb.		
	= *S. lineariloba* Rydb.		
SMIL	***Smilacina*** = ***Vagnera***	**false solomonseal**	
Smra	*racemosa* (L.) Desf.	feather solomonseal, feather solomonplume	
	= *S. racemosa* var. *amplexicaulis* Wats.		
	= *S. amplexicaulis* Nutt.		
Smst	*stellata* (L.) Desf.	starry solomonplume	starry smilac
	= *Vagnera stellata* Morong		
SMIL1	***Smilax***	**greenbrier**	
Smhe	*herbacea* L.	greenbrier	
SOLA	***Solanum***	**nightshade**	
Soam	*americanum* Mill.		
Sodu1	*dulcamara* L.	bitter nightshade	
Soel	*elaeagnifolium* Cav.	silverleaf nightshade	white horsenettle, bullnettle
Sofe	*fendleri* Gray	Fendler potato	
Sohe	*heterodoxum* Dunal	melonleaf nightshade	
Soja	*jamesii* Torr.	James nightshade	
Soni	*nigrum* L.	black nightshade	
	= *S. nodiflorum* Jacq.		
Soro	*rostratum* Dunal	buffalobur nightshade	
Sosa	*sarachoides* Sendt.		
	= *S. nigrum* var. *villosum* Mill.		
Sotr	*triflorum* Nutt.	cutleaf nightshade	
Soxa	*xantii* Gray	purple nightshade	
SOLI	***Solidago***	**goldenrod**	
Soca	*canadensis* L.	Canada goldenrod	
Socas	*salebrosa* (Piper) M.E. Jones		
	= *S. elongata* Nutt.		
Sogi	*gigantea* Ait.	giant goldenrod	
	= *S. serotina* Ait.		
Somi	*missouriensis* Nutt.	Missouri goldenrod	
	= *S. glaberrima* Martens		
	= *S. concinna* A. Nels.		
Somo	*mollis* Bartl.		
Somu	*multiradiata* Ait.		
	= *S. scopulorum* A. Nels.		
	= *S. ciliosa* Greene		
Sona	*nana* Nutt.	baby goldenrod	
	= *S. radulina* Rydb.		
Sooc	*occidentalis* (Nutt.) T. + G.	western goldenrod	
Sope	*petradoria* Blake	rock goldenrod	
	= *Petradoria pumila* Greene		
Sori	*rigida* L.	stiff goldenrod	
Sorih	*humilis* Porter		
	= *Oligoneuron canescens* Rydb.		
Sosp	*sparsiflora* Gray		
Sosp1	*speciosa* Nutt.		
Sospp	*pallida* Porter		
	= *S. pallida* Rydb.		
Sosp2	*spathulata* DC.		
Sospn	*nana* (Gray) Cronq.		
	= *S. decumbens* Greene		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Sowr	*wrightii* Gray		
SONC	***Sonchus***	**sowthistle**	
Soar1	*arvensis* L.	field sowthistle	
Soas	*asper* (L.) Hill	prickly sowthistle	
SOPH	***Sophora*** **See also under TREES AND SHRUBS**	**sophora**	
Sose2	*sericea* Nutt.	silky sophora	
SPAR2	***Sparganium***	**burreed**	
Span1	*angustifolium* Michx.	narrowleaf burreed	
Spmi	*minimum* Fries	least burreed	
SPER	***Spergularia***	**spurry**	
Spar	*arvensis* L.	corn spurry	
SPHA	***Sphaeralcea* = *Malvastrum*, in part**	**globemallow**	
Spam	*ambigua* Gray	desert globemallow	desertmallow
Span2	*angustifolia* (Cav.) D. Don.		
Spanc	*cuspidata* Gray		
	= *S. cuspidata* Britt.		
Spco1	*coccinea* (Pursh) Rydb.	scarlet globemallow	
Spfe	*fendleri* Gray	Fendler globemallow	
Spgr1	*grossulariaefolia* (H. + A.) Rydb.	gooseberryleaf globemallow	
Sppa1	*parvifolia* A. Nels.		
	= *S. arizonica* Heller		
	= *S. marginata* York		
SPIR	***Spiranthes***	**ladiestresses**	
Spro	*romanzoffiana* C. + S.	continental ladiestresses	
	= *Ibidium strictum* House		
STAC	***Stachys***	**betony**	
Stpa	*palustris* L.	marsh betony	
	= *S. pilosa* Epling		
	= *S. scopulorum* Greene		
	= *S. teucriformis* Rydb.		
	= *S. teucrifolia* Rydb.		
STAN	***Stanleya***	**princesplume**	
Stal	*albescens* M. E. Jones	Arizona princesplume	
Stpi	*pinnata* (Pursh) Britt.	desert princesplume	
	= *S. arcuata* Rydb.		
	= *S. canescens* Rydb.		
	= *S. glauca* Rydb.		
Stpib	*bipinnata* (Greene) Rollins	alkali princesplume	
	= *S. bipinnata* Greene		
Stpii	*integrifolia* (James) Rollins	wholeleaf desert princesplume	
	= *S. integrifolia* James		
Stto	*tomentosa* Parry	woolly princesplume[61]	
STEL	***Stellaria* = *Alsine***	**starwort**	
Stca	*calycantha* (Ledeb.) Bong.		
	= *S. borealis* Bigel.		
Stcr	*crassifolia* Ehrh.		
Stja	*jamesiana* Torr.	tuber starwort	
	= *Alsine curtisii* Rydb.		
Stlo3	*longifolia* Willd.		
Stlo2	*longipes* Goldie	longstalk starwort	
	= *Alsine strictiflora* Rydb.		
Stme	*media* (L.) Cyrill.	chickweed starwort	

[61] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Stob	*obtusa* Engelm.		
	= *Alsine polygonoides* Greene		
Stum	*umbellata* Turcz.		
	= *Alsine baicalensis* Cov.		
STEP	***Stephanomeria***	**wirelettuce**	
Stex	*exigua* Nutt.		
	= *Ptiloria exigua* Greene		
STRE1	***Streptanthus***	**twistflower**	
Star1	*arizonicus* Wats.		
Stco3	*cordatus* Nutt.	heartleaf twistflower	
	= *S. coloradensis* A. Nels.		
STRE	***Streptopus***	**twistedstalk**	
Stam	*amplexifolius* (L.) DC.	claspleaf twistedstalk	
SUAE	***Suaeda* = *Dondia***	**seepweed**	
Sude	*depressa* (Pursh) Wats.	pursh seepweed	
Sudee	*erecta* Wats.		
	= *S. erecta* A. Nels.		
Sufr1	*fruticosa* (L.) Forsk.	alkali seepweed	
	= *S. moquinii* A. Nels.		
Suni	*nigra* (Raf.) Macbr.		
	= *S. diffusa* Wats.		
Suoc	*occidentalis* Wats.	western seepweed	
Suto	*torreyana* Wats.	Torrey seepweed	
SWER	***Swertia***	**swertia**	
Swpe	*perennis* L.	alpinebog swertia	
	= *S. palustris* A. Nels.		
	= *S. scopulina* Greene		
	= *S. congesta* A. Nels.		
TAGE	***Tagetes***	**marigold**	
Tale	*lemmonii* Gray		stinking marigold
Tami	*micrantha* Cav.	little marigold	wild marigold
TALI	***Talinum***	**fameflower**	
Taca	*calycinum* Engelm.	rockpink fameflower	
Tapa1	*parviflorum* Nutt.	prairie fameflower	
TARA	***Taraxacum***	**dandelion**	
Tace	*ceratophorum* (Ledeb.) DC.	rough dandelion	
Taer	*eriophorum* Rydb.		
Taof	*officinale* Weber	common dandelion	
	= *T. vulgare* Schrank		
	= *T. taraxacum* Karst.		
	= *T. mexicanum* DC.		
TELE	***Telesonix***		
Teja	*jamesii* (Torr.) Raf.		
	= *Saxifraga jamesii* Torr.		
Tejah	*heucheriformis* (Rydb.) Bacig.		
	= *Saxifraga heucheriformis* M. E. Jones		
TEUC	***Teucrium***	**germander**	
Tela	*laciniatum* Torr.		
THAL	***Thalictrum***	**meadowrue**	
Thal1	*alpinum* L.	alpine meadowrue	
Thda	*dasycarpum* Fisch. Mey. + Lall.	purple meadowrue	
	= *T. purpurascens* of some manuals		
Thfe1	*fendleri* Gray		
	= *T. stipitatum* Rydb.		

Forbs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Thoc	*occidentale* Gray	western meadowrue	
	= *T. megacarpum* Torr.		
Thsp	*sparsiflorum* Turcz.		
Thve	*venulosum* Trel.	veiny meadowrue	
THEL	***Thelesperma***	**greenthread**	
Tham	*ambiguum* Gray	Colorado greenthread	
Thfi	*filifolium* Gray		
Thfii	*intermedium* (Rydb.) Shinners		
	= *T. intermedium* Rydb.		
	= *T. trifidum* Britt.		
Thlo	*longipes* Gray	cota greenthread	cota
Thme	*megapotamicum* (Spreng.) Kuntze		
	= *T. gracile* Gray		
Thsu	*subnudum* Gray	Navajo-tea greenthread	
THEL1	***Thelypodium***	**thelypody**	
Thin2	*integrifolium* (Nutt.) Endl.		
	= *T. lilacinum* Greene		
THER	***Thermopsis***	**thermopsis**	
Thdi	*divaricarpa* A. Nels.	spreading thermopsis	
Thmo1	*montana* Nutt.	mountain thermopsis	
Thmoo	*ovata* (Robins.) St. John		
	= *T. ovata* Rydb.		
Thpi	*pinetorum* Greene	pine thermopsis	
Thrh	*rhombifolia* Rich.	prairie thermopsis	
	= *T. arenosa* A. Nels.		
THLA	***Thlaspi***	**pennycress**	
Thar	*arvense* L.	field pennycress	
Thfe	*fendleri* Gray	Fendler pennycress[62]	
	= *T. purpurascens* Rydb.		
Thfef	*fendleri*		
	= *T. alpestre* of Am. authors		
	= *T. glaucum* A. Nels.		
Thfec	*coloradense* (Rydb.) Maguire		
	= *T. coloradense* Rydb.		
Thpa	*parviflorum* A. Nels.	few-flowered pennycress	
THYS	***Thysanocarpus***		**lacepod**
TIDE	***Tidestromia***	**tidestromia**	
Tila	*lanuginosa* (Nutt.) Standl.	woolly tidestromia	
Tiob	*oblongifolia* (Wats.) Standl.	honeysweet tidestromia	shrubby tidest
TILL	***Tillaea***	**pygmyweed**	**pigmyweed**
Tiaq	*aquatica* L.	sand pygmyweed[63]	pigmyweed
TOWN	***Townsendia***	**townsendia**	
Toex1	*exscapa* (Richards.) Porter	stemless townsendia	
	= *T. sericea* Hook., in part		
Toex	*eximia* Gray		
	= *T. vreelandii* Rydb.		
Togl	*glabella* Gray		
Togr	*grandiflora* Nutt.		
Toin	*incana* Nutt.	hoary townsendia	
	= *T. arizonica* Gray		
	= *T. diversa* Osterh.		

[62] Suggested common name.
[63] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
Topa	*parryi* D. C. Eat.	Parry townsendia	
Tost	*strigosa* Nutt.		
TRAD	***Tradescantia***	**spiderwort**	
Troc	*occidentalis* (Britt.) Smyth = *T. laramiensis* Goodd. = *T. universitatis* Cockll.	prairie spiderwort	
TRAG2	***Tragia***	**noseburn**	
Trne1	*nepetaefolia* Cav.	catnip noseburn[64]	
Trra	*ramosa* Torr.	branching noseburn[65]	
Trur	*urticifolia* Michx.	nettle-leaf noseburn[66]	
TRAG1	***Tragopogon***	**salsify**	
Trdu1	*dubius* Scop.		
Trpo	*porrifolius* L.	vegetable-oyster salsify	salsify oysterplant
Trpr2	*pratensis* L.	meadow salsify	meadow goatsbeard[67]
TRAU	***Trautvetteria***	**false bugbane**	
Trca3	*carolinensis* (Walt.) Vail = *T. grandis* Nutt. = *T. media* Greene	Carolina tassel-rue[68]	
TRIA	***Trianthema***	**horse-purslane**	
Trpo1	*portulacastrum* L.	desert horse-purslane	
TRIB	***Tribulus***		
Trte	*terrestris* L.	puncturevine	
TRIC1	***Trichostema***	**bluecurls**	
Trbr	*brachiatum* L. = *Isanthus brachiatus* B.S.P.	fluxweed	
TRIF	***Trifolium* L.**	**clover**	
Tral2	*albopurpureum* T. + G.	rancheria clover	
Trbe1	*beckwithii* Wats.	Beckwith clover	
Trbr1	*brandegei* Wats.	Brandegee clover	
Trda	*dasyphyllum* T. + G. = *T. uintense* Rydb.	whiproot clover	
Trdu	*dubium* Sibth.	suckling clover	
Trfe	*fendleri* Greene	Fendler clover	
Trgy	*gymnocarpon* Nutt.	hollyleaf clover	
Trgys	*subacaulescens* (Gray) A. Nels. = *T. subacaulescens* Gray = *T. nemorale* Greene		
Trha	*haydenii* Porter	Hayden clover	
Trhy	*hybridum* L.	alsike clover	
Trki	*kingii* Wats.	Kings clover	
Trlo	*longipes* Nutt.	longstalk clover	
Trlop	*pygmaeum* Gray = var. *rusbyi* Harrington		
Trna	*nanum* Torr.	dwarf clover	
Trne	*neurophyllum* Greene	Mogollon clover	bighead clover[69]
Trpa	*parryi* Gray = *T. montanense* Rydb.	Parry clover	

[64] Suggested common name.
[65] Suggested common name.
[66] Suggested common name.
[67] Goatsbeard is accepted common name for *Aruncus*.
[68] Suggested common name.
[69] Bighead clover is common name for *Trifolium macrocephalum*.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Trpr	*pratense* L.	red clover	
Trre	*repens* L.	white clover	
TRIG	***Triglochin***	**podgrass**	**arrowgrass**
Trma	*maritimum* L.	shore podgrass	
TRIL	***Trillium***	**trillium**	**wakerobbin**
Trov	*ovatum* Pursh	Pacific trillium	
TRIO	***Triodanis* = *Specularia***	**venuslookingglass**	
Trbi	*biflora* (R. + P.) Greene	small venuslookingglass	
	= *S. biflora* Fisch. + Mey.		
Trle	*leptocarpa* (Nutt.) Nieuwl.		
	= *S. leptocarpa* Gray		
Trpe	*perfoliata* (L.) Nieuwl.	clasping venuslookingglass	
	= *S. perfoliata* DC.		
TROL	***Trollius***	**globeflower**	
Trla	*laxus* Salisb.		
	= *T. albiflorus* Rydb.	American globeflower	
TYPH	***Typha***	**cattail**	
Tydo	*domingensis* Pers.	Dominican cattail[70]	
	= *T. angustifolia* of some authors		
Tyla	*latifolia* L.	common cattail	broadleaf ca
URTI	***Urtica***	**nettle**	
Urdil	*dioica* L.	bigsting nettle	
Urdip	*procera* (Muhl.) Wedd.		
	= *U. gracilenta* Greene		
	= *U. gracilis* Ait.		
	= *U. lyallii* Wats.		
	= *U. procera* Willd.		
	= *U. viridis* Rydb.		
VACC1	***Vaccaria* = *Saponaria***		
Vase	*segetalis* (Neck.) Asch.	cow soapwort	
	= *Saponaria vaccaria* L.		
VALE	***Valeriana***	**valerian**	
Vaac	*acutiloba* Rydb.	sharpleaf valerian	
	= *V. capitata* ssp. *acutiloba* F. G. Mey.		
	= *V. pubicarpa* Rydb.		
Vaed	*edulis* Nutt.	edible valerian	
	= *V. ceratophylla* Piper		
	= *V. trachycarpa* Rydb.		
Vaoc	*occidentalis* Heller	western valerian	
	= *V. micrantha* E. Nels.		
VERA	***Veratrum***	**falsehellebore**	
Veca	*californicum* Durand	California falsehellebore	
	= *V. speciosum* Rydb.		
	= *V. tenuipetalum* Heller		
VERB1	***Verbascum***	**mullein**	
Vebl	*blattaria* L.	moth mullein	
Veth	*thapsus* L.	flannel mullein	
Vevi	*virgatum* Stokes	purplestamen mullein	
VERB2	***Verbena***	**verbena**	
Vebi	*bipinnatifida* Nutt.	Dakota verbena	

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[70] Suggested common name.

Forbs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
Vebr	*bracteata* Lag. + Rodr. = *V. bracteosa* Michx.	bigbract verbena	
Veci	*ciliata* Benth.		
Veha	*hastata* L.	blue verbena	
Vema	*macdougalii* Heller		
Vest	*stricta* Vent.	woolly verbena	
Vewr	*wrightii* Gray	Wrights verbena	
VERB3	***Verbesina***	**crownbeard**	
Veen	*encelioides* (Cav.) B. + H.	golden crownbeard	
VERO	***Veronica***	**speedwell**	
Veag	*agrestis* L.	field speedwell	
Veam	*americana* Schwein.	American speedwell	
Vean	*anagallis-aquatica* L.	water speedwell	
Vear	*arvensis* L.	common speedwell	
Vepe	*peregrina* L.	purslane speedwell	
Vepex	*xalapensis* (H.B.K.) Pennell		
Vese	*serpyllifolia* L. = *V. humifusa* Dicks.	thymeleaf speedwell	
Vewo	*wormskjoldii* R. + S. = *V. alpina* var. *wormskjoldii* Hook.		
VICI	***Vicia* L.**	**vetch**	
Viam	*americana* Muhl.	American vetch	
Viama	*americana*		
Viamm	*minor* Hook.		
Viamo	*oregana* (Nutt.) A. Nels.		
Viamt	*truncata* (Nutt.) Brew.		
Vian1	*angustifolia* L.	narrowleaf vetch	
Viex	*exigua* Nutt.	slim vetch	
Vile	*leucophaea* Greene	Mogollon vetch	
Vipu1	*pulchella* H.B.K.	sweetclover vetch	
Visa	*sativa* L.	common vetch	fodder vetch
Vivi	*villosa* Roth	hairy vetch	
VIGU	***Viguiera* = *Gymnolomia***	**goldeneye**	
Vian	*annua* (M.E. Jones) Blake	annual goldeneye	
Vico	*cordifolia* Gray	heartleaf goldeneye	
Vide	*deltoidea* Gray		shrubby goldeneye
Videp	*parishii* (Greene) Vasey + Rose	Parish goldeneye	
Vilo	*longifolia* (Robins. + Greenm.) Blake	longleaf goldeneye	
Vimu	*multiflora* (Nutt.) Blake	showy goldeneye	
Vimun	*nevadensis* (A. Nels.) Blake = *Gymnolomia nevadensis* A. Nels.	Nevada showy goldeneye	
Viov	*ovalis* Blake	ovalleaf goldeneye	
VIOL	***Viola***	**violet**	
Viad	*adunca* J. E. Sm.	hook violet	
Viada	*adunca*		
Vica	*canadensis* L.	Canada violet	
Vicar	*rugulosa* (Greene) C.L. Hitchc. = *V. rugulosa* Greene = *V. rydbergii* Greene		
Vicas	*scopulorum* Gray = *V. scopulorum* Greene		
Vine	*nephrophylla* Greene	wanderer violet	
Vinea	*arizonica* (Greene) K. + P.		
Vinu	*nuttallii* Pursh	Nuttall violet	
Vinum	*major* Hook. = *V. linguaefolia* Nutt. = *V. praemorsa* Lindl. = *V. erectifolia* A. Nels.		

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
Vinuv	*vallicola* (A. Nels.) St. Johns		
	= *V. vallicola* A. Nels.		
Vipa	*palustris* L.	marsh violet	
Vipab	*brevipes* Davis		
Vipal	*papilionacea* Pursh		
	= *V. retusa* Greene		
Vipe	*pedatifida* G. Don	prairie violet	
Vipu2	*purpurea* Kellogg	goosefoot violet	
Vish	*sheltonii* Torr.	Shelton violet	
WISL	***Wislizenia***		
Wire	*refracta* Engelm.		jackass-clove
WOOD	***Woodsia***	**woodsia**	
Woob	*obtusa* (Spreng.) Torr.	common woodsia	
Woor	*oregona* D.C. Eat.	Oregon woodsia	
Wosc	*scopulina* D. C. Eat.	RockyMountain woodsia	
WOOD1	***Woodwardia***	**chainfern**	
Wofi	*fimbriata* J. E. Sm.	giant chainfern	chainfern
WYET	***Wyethia***	**wyethia**	
Wyam	*amplexicaulis* Nutt.	mulesears wyethia	
Wyar	*arizonica* Gray	Arizona wyethia[71]	
Wyhe	*helianthoides* Nutt.	whitehead wyethia	
Wysc	*scabra* Hook.		
XANT	***Xanthium***	**cocklebur**	
Xasp	*spinosum* L.	spiny cocklebur	
Xast	*strumarium* L.		
	= *X. chinense* Mill.		
	= *X. italicum* Moretti		
	= *X. pennsylvanicum* Wallr.		
ZANN	***Zannichellia***	**poolmat**	**horned-pond**
Zapa	*palustris* L.	common poolmat	horned-pond
ZAUS	***Zauschneria***	**firechalice**	
Zaca	*californica* Presl		
Zacal	*latifolia* (Hook.) Keck (ssp.)	broadleaf firechalice	hummingbirc firechalic
ZIGA	***Zigadenus***	**deathcamas**	
Ziel	*elegans* Pursh	mountain deathcamas	
	= *Anteclea elegans* Rydb.		
	= *Z. coloradensis* Rydb.		
Zipa	*paniculatus* (Nutt.) Wats.	foothill deathcamas	
Zive	*venenosus* Wats.	meadow deathcamas	
Ziveg	*gramineus* (Rydb.) Walsh		
	= *Z. gramineus* Rydb.		
	= *Z. intermedius* Rydb.		
ZINN	***Zinnia***	**zinnia**	
Zigr	*grandiflora* Nutt.	RockyMountain zinnia	
Zimu	*multiflora* L.	redstar zinnia	
ZIZI1	***Zizia***	**zizia**	
Ziap	*aptera* (Grav) Fern.		
	= *Z. cordata* of some manuals		
Ziau	*aurea* (L.) Koch	golden zizia	

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[71] Suggested common name.
[72] Pondweed is the accepted common name for *Potamogeton*.

Trees and Shrubs

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
ABIE	***Abies***	**fir**	
Abco	*concolor* (Gord. + Glend.) Hildebr.	white fir	
Abla	*lasiocarpa* (Hook.) Nutt.	subalpine fir	alpine fir
Ablaa	*arizonica* (Merriam) Lemm.	corkbark fir	
ABUT	***Abutilon***	**abutilon**	**Indianmallow**
ACAC	***Acacia***	**acacia**	
Acan	*angustissima* (Mill.) Kuntze	prairie acacia	whiteball acacia
Acco1	*constricta* Benth.	mescat acacia	whitethorn
Acfa	*farnesiana* (L.) Willd.	sweet acacia	
Acgr	*greggii* Gray	catclaw acacia	
ACAL	***Acalypha***	**copperleaf**	
Acli	*lindheimeri* Muell. Arg.	Lindheimer copperleaf	crimson acalypha
ACAM	***Acamptopappus***	**goldenhead**	
Acsp	*sphaerocephalus* (Harv. + Gray) Gray	rayless goldenhead	
ACER	***Acer***	**maple**	
Acgl	*glabrum* Torr.	RockyMountain maple	
Acgr1	*grandidentatum* Nutt.	bigtooth maple	
Acne	*negundo* L.	boxelder	
	= *A. interior* Britt.	inland boxelder	
	= *A. negundo* var. *interior Sarg.*		
	= *Negundo interius* Rydb.		
AGAV	***Agave***	**agave**	
Agde	*deserti* Engelm.		desert agave
Agka	*kaibabensis* McKelvey		Kaibab agave
Agpa2	*palmeri* Engelm.	Palmer agave	centuryplant
Agpa3	*parryi* Engelm.	Parry agave	mescal
Agpa4	*parviflora* Torr.		small-flowered agave
Agsc3	*schottii* Engelm.		Schott agave, amole
Agut	*utahensis* Engelm.	Utah agave	
ALNU	***Alnus***	**alder**	
Alob	*oblongifolia* Torr.	Arizona alder	NewMexican alder
Alte	*tenuifolia* Nutt.	thinleaf alder	mountain alder
ALOY	***Aloysia***	**lippia**	
Alwr	*wrightii* (Gray) Heller	Wright lippia	Wright lemon-verbena
	= *Lippia wrightii* Gray		
AMEL	***Amelanchier***	**serviceberry**	
Amal	*alnifolia* Nutt.	saskatoon serviceberry	
Amalp	*pumila* (Nutt.) A. Nels.	dwarf saskatoon serviceberry	serviceberry
	= *A. pumila* M. Roem.		
Amut	*utahensis* Koehne	Utah serviceberry	
	= *A. alnifolia* var. *utahensis* M.E. Jones		
	= *A. oreophila* A. Nels.	mountain serviceberry	
AMOR	***Amorpha***	**amorpha**	
Amca	*californica* Nutt.	California amorpha	stinkingwillow amorpha
Amca1	*canescens* Pursh	leadplant amorpha	
Amfr1	*fruticosa* L.	indigobush amorpha	

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	 OTHER
Amna	*nana* Nutt.	dwarfindigobush amorpha	
	= *A. microphylla* Pursh		
AMPH	***Amphipappus***		
Amfr2	*fremontii* T. + G.		chaffbush, broomwee
ANIS	***Anisacanthus***	**anisacanth**	
Anth	*thurberi* (Torr.) Gray	Thurber anisacanth	desert-honeysu
ARBU	***Arbutus***	**madrone**	
Arar2	*arizonica* (Gray) Sarg.	Arizona madrone	
Arte2	*texana* Buckl.	Texas madrone	
ARCE	***Arceuthobium = Razoumofskya***	**dwarf mistletoe**	
Aram	*americanum* Engelm.	lodgepole pine dwarf mistletoe	
	= *R. americana* Kuntze		
Ardi1	*divaricatum* Engelm.	pinyon dwarf mistletoe	
	= *A. campylopodum* forma *divaricatum* Gill		
	= *R. divaricata* Cov.		
Ardo	*douglasii* Engelm.	Douglas-fir dwarf mistletoe	
	= *R. douglasii* Kuntze		
Arva	*vaginatum* (Willd.) Presl	southwestern dwarf mistletoe	
	= *A. cryptopodum* Engelm.		
	= *R. cryptopoda* Cov.		
	= *Viscum vaginatum* Willd.		
ARCT1	***Arctostaphylos***	**manzanita**	
Arne	*nevadensis* var. *coloradensis* (Rollins) Harrington	pinemat manzanita	
	= *A. coloradensis* Rollins		
Arpa4	*parryana* Lemmon		
Arpap	*pinetorum* (Rollins) Wies. + Schreib.	pine manzanita	
	= *A. pinetorum* Rollins		
Arpa3	*patula* Greene	greenleaf manzanita	
	= *A. platyphylla* Kuntze		
	= *A. pungens* var. *platyphylla* Gray		
Arpr	*pringlei* Parry	Pringle manzanita	
Arpu2	*pungens* H.B.K.	pointleaf manzanita	
Aruv	*uva-ursi* (L.) Spreng.	bearberry	kinnikinnick
ARTE	***Artemisia*** **See also under FORBS**	**sagebrush**	**wormwood**
Arar5	*arbuscula* Nutt.	low sagebrush	
	= *A. tridentata* var. *arbuscula* McMinn		
	= *A. tridentata* spp. *arbuscula* H. + C.		
Arbi1	*bigelovii* Gray[73]	Bigelow sagebrush	
Arca3	*cana* Pursh	silver sagebrush	
Arca5	*carruthii* Carruth[74]	Carruth sagebrush	
	= *A. bakeri* Greene		
	= *A. coloradoensis* Osterh.		
	= *A. wrightii* Gray	Wrights sagebrush	
Arfi	*filifolia* Torr.	sand sagebrush	

[73] Subshrub, woody at base only.
[74] Subshrub, woody at base only.

Trees and Shrubs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Arfr1	*frigida* Willd.[75]	fringed sagebrush	estafiata
Armi3	*michauxiana* Bess. = *A. discolor* Bess.	Michaux sagebrush	
Arno	*nova* A. Nels. = *A. arbuscula* var. *nova* (A. Nels.) Cronq. = *A. tridentata* var. *nova* McMinn	black sagebrush	
Arpe1	*pedatifida* Nutt.[76]	birdfoot sagebrush	
Arpy	*pygmaea* Gray[77]		pygmy sagebrush
Arsp	*spinescens* D.C. Eat.	bud sagebrush	budsage, buttonsage
Artr	*tridentata* Nutt.	big sagebrush	
Artr1	*tripartita* Rydb. = *A. tridentata* ssp. *trifida* H. + C. = *A. trifida* Nutt.	threetip sagebrush	
ATRI	***Atriplex***	**saltbush**	**saltsage, sage, spearscale, redscale, arrowscale, wedgescale**
Atca	*canescens* (Pursh) Nutt. = *A. occidentalis* D. Dietr.	fourwing saltbush	chamiza, estafietta
Atco	*confertifolia* (Torr. + Frem.) Wats.	shadscale saltbush	spiny saltbush, shadscale
Atco1	*corrugata* Wats.		
Atga	*gardneri* (Moq.) Standl.[78] = *A. nuttallii* ssp. *gardneri* H. + C.	Gardner saltbush	
Athy	*hymenelytra* (Torr.) Wats.	desertholly saltbush	desertholly
Atle	*lentiformis* (Torr.) Wats.	big saltbush	quailbrush, lenscale, quailbush
Atob	*obovata* Moq.[79]		
Atpo	*polycarpa* (Torr.) Wats.	cattle saltbush	desert saltbush, cattle-spinach
Atse	*semibaccata* R. Br.	Australian saltbush	
AYEN	***Ayenia***	**ayenia**	
Aymi	*microphylla* Gray		littleleaf ayenia
Aypi	*pilosa* Cristobal = *A. pusilla* of some authors	dwarf ayenia	
BACC	***Baccharis***	**baccharis**	
Babr	*brachyphylla* Gray	shortleaf baccharis	
Baem	*emoryi* Gray	Emory baccharis	
Bagl	*glutinosa* Pers.	seepwillow baccharis	seepwillow
Bapt	*pteronioides* DC. = *B. ramulosa* Gray	yerbadepasmo baccharis	yerbadepasmo
Basa1	*sarothroides* Gray	broom baccharis	
Base	*sergiloides* Gray	squaw baccharis	
Bavi	*viminea* DC.	mulefat baccharis	
BEBB	***Bebbia***	**bebbia**	
Beju	*juncea* (Benth.) Greene	rush bebbia	

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[75] Subshrub, woody at base only.
[76] Subshrub, woody at base only.
[77] Subshrub, woody at base only.
[78] Subshrub, woody at base only.
[79] Subshrub, woody at base only.

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
BELO	***Beloperone***	**beloperone**	
Beca	*californica* Benth.	California beloperone	chuparosa
BERB	***Berberis* = *Mahonia* = *Odostemon***	**barberry**	
Befe	*fendleri* Gray	Colorado barberry	
Befr	*fremontii* Torr.	Fremont mahonia	
	= *Mahonia fremontii* Fedde		
Beha	*haematocarpa* Woot.	red mahonia	
	= *M. haematocarpa* Fedde		
Bere	*repens* Lindl.	creeping mahonia	Oregongrape
	= *M. repens* G. Don		
Betr	*trifoliolata* Moric.	Laredo mahonia	algerita
	= *M. trifoliolata* Fedde		
BETU	***Betula***	**birch**	
Begl	*glandulosa* Michx.	bog birch	
Beoc	*occidentalis* Hook.	water birch	red birch
	= *B. fontinalis* Sarg.		
Bepa	*papyrifera* Marsh.	paper birch	
	= *B. occidentalis* of some authors		
BOUV	***Bouvardia***	**bouvardia**	
Bogl	*glaberrima* Engelm.		honeysuckle bouvardia
	= *B. ovata* Gray		
BRIC	***Brickellia* = *Coleosanthus***	**brickellia**	**brickellbush**
Brca3	*californica* (T. + G.) Gray	California brickellia	California brickellbu
Brde	*desertorum* Cov.	desert brickellia	desert brickell
Brfl	*floribunda* Gray	bigleaf brickellia	bigleaf brickellbu
Brfr2	*frutescens* Gray	rigid brickellia	rigid brickellb
Brgr	*grandiflora* (Hook.) Nutt.	tasselflower brickellia	tasselflower brickellbu
Brin2	*incana* Gray	white brickellia	white brickell
Brlo	*longifolia* Wats.	longleaf brickellia	longleaf brickellbu
Brmu	*multiflora* Kell.	Inyo brickellia	Inyo brickellb
Brob	*oblongifolia* Nutt.	Mohave brickellia	Mohave bricke
Brru2	*rusbyi* Gray		stinking brickellbu
BUME	***Bumelia***	**bumelia**	
Bula	*lanuginosa* (Michx.) Pers.	gum bumelia	woollybucket bumelia
Bular	*rigida* Gray		
BURS	***Bursera***	**bursera**	
Bufa	*fagaroides* (H.B.K.) Engler	fragrant bursera	
Bumi	*microphylla* Gray	elephanttree	elephant burse
CALI	***Calliandra***	**calliandra**	
Caer	*eriophylla* Benth.	falsemesquite calliandra	
Cahu	*humilis* (Schlecht.) Benson	dwarf calliandra	
Care	*reticulata* Gray	netvein calliandra	
CANO	***Canotia***	**canotia**	
Caho	*holacantha* Torr.	canotia	crucifixion-tho
CARL	***Carlowrightia***	**carlowrightia**	
Caar1	*arizonica* Gray	Arizona carlowrightia	
Cali2	*linearifolia* (Torr.) Gray	heath carlowrightia	

Trees and Shrubs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
CARN	***Carnegiea***		
Cagil	*gigantea* (Engelm.) Britt. + Rose = *cereus giganteus* Engelm.	saguaro	sahuaro
CASS	***Cassia*** **See also under FORBS**	**senna**	
Caar2	*armata* Wats.	desert senna	
Cawi	*wislizenii* Gray	Wislizenus senna	
CEAN	***Ceanothus***	**ceanothus**	
Cefe	*fendleri* Gray	Fendler ceanothus	buckbrush
Cegr	*greggii* Gray	desert ceanothus	
Cein1	*integerrimus* H. + A.	deerbrush ceanothus	deerbrush
Ceov	*ovatus* Desf. = *C. herbaceus* Raf.	inland ceanothus	
Ceve	*velutinus* Hook.	snowbrush ceanothus	
CELA	***Celastrus***	**bittersweet**	
Cesc	*scandens* L.	American bittersweet	
CELT	***Celtis***	**hackberry**	
Cepa2	*pallida* Torr.	spiny hackberry	granjeno
Cere	*reticulata* Torr. = *C. douglasii* Planch. = *C. rugulosa* Rydb.	netleaf hackberry	paloblanco
CEPH	***Cephalanthus***	**buttonbush**	
Ceoc	*occidentalis* L.	common buttonbush	
CERC2	***Cercidium***	**paloverde**	
Cefl	*floridum* Benth.	blue paloverde	
Cemi	*microphyllum* (Torr.) Rose + Johnst.	yellow paloverde	littleleaf paloverde
CERC3	***Cercis***	**redbud**	
Ceoc1	*occidentalis* Gray	California redbud	
CERC1	***Cercocarpus***	**cercocarpus**	**mountainmahogany**
Cebe1	*betuloides* Nutt.	birchleaf cercocarpus	birchleaf mountainmahogany
Cebr	*breviflorus* Gray	hairy cercocarpus	hairy mountainmahogany
Cein2	*intricatus* Wats.	littleleaf cercocarpus	littleleaf mountainmahogany
Ceinv	*villosus* Schneid. = *C. arizonicus* M.E. Jones	Arizona cercocarpus[80]	
Cele	*ledifolius* Nutt.	curlleaf cercocarpus	curlleaf mountainmahogany
Cemo	*montanus* Raf.		true mountainmahogany
CHAM	***Chamaebatiaria***		
Chmi	*millefolium* (Torr.) Maxim.	tansybush	fernbush, desertsweet
CHIL	***Chilopsis***		
Chli	*linearis* (Cav.) Sweet	desertwillow	
CHOI	***Choisya***	**Mexicanorange**	
Char	*arizonica* Standl. = *C. dumosa* var. *arizonica* Benson	Arizona starleaf[81]	starleaf Mexican-orange
CHRY1	***Chrysothamnus* = *Bigelovia*, in part**	**rabbitbrush**	
Chde	*depressus* Nutt.	dwarf rabbitbrush	

[80] Suggested common name.
[81] Suggested common name.

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Chgr	*greenei* (Gray) Greene	Greenes rabbitbrush	
Chgrf	*filifolius* (Rydb.) Blake		
	= *C. filifolius* Rydb.		
	= *C. greenei* ssp. *filifolius* H. + C.		
	= *C. laricinus* Greene		
Chna	*nauseosus* (Pall.) Britt.	rubber rabbitbrush	
Chnab	*bigelovii* (Gray) Hall	Bigelow rubber rabbitbrush	
	= *C. bigelovii* Greene		
	= *C. nauseosus* ssp. *bigelovii* H. + C.		
Chnag	*graveolens* (Nutt.) Hall	greenplume rubber rabbitbrush	
	= *Bigelowia graveolens* Gray		
	= *C. nauseosus* ssp. *graveolens* Piper		
Chnap	*pinifolius* (Greene) Hall	pineneedle rubber rabbitbrush	
	= *C. nauseosus* ssp. *pinifolius* (Greene) H. + C.		
	= *C. pinifolius* Greene		
Chnas	*speciosus* (Nutt.) Hall	tall rubber rabbitbrush	
	= *C. nauseosus* ssp. *speciosus* H.M. + C.		
	= *C. speciosus* Nutt.		
Chpa2	*paniculatus* (Gray) Hall	desert rabbitbrush	
Chpa3	*parryi* (Gray) Greene	Parry rabbitbrush	
Chpaa	*attenuatus* (Jones) Kittell		
	= *C. attenuatus* Rydb.		
	= *C. parryi* ssp. *attenuatus* H. + C.		
Chpah	*howardii* (Parry) Kittell	Howard rabbitbrush	
	= *C. howardii* Greene		
Chpu	*pulchellus* (Gray) Greene	southwest rabbitbrush	
Chte	*teretifolius* (Dur. + Hilg.) Hall	roundleaf rabbitbrush	
Chva	*vaseyi* (Gray) Greene	Vasey rabbitbrush	
	= *C. bakeri* Greene		
Chvi3	*viscidiflorus* (Hook.) Nutt.	Douglas rabbittbrush	
Chvil	*lanceolatus* (Nutt.) Greene	lanceleaf rabbitbrush	
	= *C. lanceolatus* Nutt.		
	= *C. viscidiflorus* ssp. *lanceolatus* Piper		
Chvip	*pumilus* (Nutt.) Jeps.	low Douglas rabbitbrush	
	= *C. pumilus* Nutt.		
	= *C. viscidiflorus* ssp. *pumilus* H. + C.		
Chviv	*viscidiflorus*		
	= *C. glaucus* A. Nels.		
	= *C. stenolepis* Rydb.		
	= *C. serrulatus* Rydb.		
	= *C. viscidiflorus* ssp. *typicus* H. + C.		
CLEM	*Clematis*	clematis	

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Clco	*columbiana* (Nutt.) T. + G.		
	= *Atragene columbiana* Nutt.		
	= *C. occidentalis* A. Nels.		
	= *C. verticillaris* var. *columbiana* Gray		
Clhi	*hirsutissima* Pursh[82]		
	= *C. douglasii* Hook.		
	= *C. eriophora* Rydb.		
	= *Viorna douglasii* Cockll.		
	= *Viorna hirsutissima* Heller		
Clhis	*scottii* (Porter) Erickson[83]	Scott clematis	
	= *Clematis scottii* Porter		
	= *Viorna scottii* Rydb.		
Clli	*ligusticifolia* Nutt.	western virginsbower	virginsbower
Clps	*pseudoalpina* (Kuntze) A. Nels.	RockyMountain clematis	
	= *Atragene pseudoalpina* Rydb.		
	= *Clematis alpina* var. *occidentalis* Gray		
COLD	***Coldenia***	**coldenia**	
Coca2	*canescens* DC.	spreading coldenia	
Copl	*plicata* (Torr.) Cov.	desertmat coldenia	
COLE	***Coleogyne***	**blackbrush**	
Cora1	*ramosissima* Torr.	blackbrush	
COND	***Condalia***	**condalia**	
Cogl	*globosa* Johnst.	bitter condalia	
Coly	*lycioides* (Gray) Weberb.	lotewood condalia	lotebush condalia
Come2	*mexicana* Schlecht.	Mexican condalia	Mexican bluewood
Cosp	*spathulata* Gray	knifeleaf condalia	squawbush
CORN	***Cornus***	**dogwood**	
Coca3	*canadensis* L.[84]	bunchberry dogwood	
Cost1	*stolonifera* Michx.	red-osier dogwood	squawbush
	= *C. baileyi* Coult. + Evans		
	= *C. interior* Peters.		
	= *Svida stolonifera* Rydb.		
CORY3	***Corylus***	**filbert, hazel**	
Coco1	*cornuta* Marsh.	beaked hazel	beaked filbert
	= *C. rostrata* Ait.		
CORY2	***Coryphantha* = *Mammillaria*, in part**	**coryphantha**	
Coag	*aggregata* (Engelm.) Britt. + Rose	golfball coryphantha	golfball cactus
	= *Mammillaria aggregata* Engelm.		
Coar2	*arizonica* (Engelm.) Britt. + Rose	Arizona coryphantha	Arizona mammillaria
	= *Mammillaria arizonica* Engelm.		
Coch	*chlorantha* (Engelm.) Britt. + Rose		foxtail cactus
	= *Mammillaria chlorantha* Engelm.		
Cone	*neomexicana* (Engelm.) Britt. + Rose	spinystars coryphantha	
	= *Mammillaria neomexicana* A. Nels.		
	= *Mammillaria radiosa* var. *neomexicana* Engelm.		
Coro	*robustispina* (Schott) Britt. + Rose	spikespine coryphantha	spikespine cactus
	= *Mammillaria robustispina* Schott		

[82] Woody at base only.

[83] Woody at base only.

[84] This is a perennial herb, with rootstock.

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
Covi	*vivipara* (Nutt.) Britt. + Rose		
	= *Mammillaria vivipara* Haw.		
COWA	***Cowania***	**cliffrose**	
Come1	*mexicana* D. Don	cliffrose	quinine-bush, buckbrush
	= *C. stansburiana* Torr.		
CRAT	***Crataegus***	**hawthorn**	
Crch	*chrysocarpa* Ashe	fireberry hawthorn	
Crdo	*douglasii* Lindl.	black hawthorn	Douglas hawthor
Crer	*erythropoda* Ashe	Cerro hawthorn	
	= *C. cerronis* A. Nels.		
Crri	*rivularis* Nutt.	river hawthorn	
Crsa1	*saligna* Greene	willow hawthorn	
Crsu	*succulenta* Link	fleshy hawthorn	
	= *C. coloradensis* A. Nels.		
CROT2	***Croton* See also under FORBS**	**croton**	
Crfr	*fruticulosus* Engelm.	bush croton	
CUPR	***Cupressus***	**cypress**	
Cuar	*arizonica* Greene	Arizona cypress	
DALE	***Dalea*** **See also under FORBS**	**dalea**	
Dasp2	*spinosa* Gray	smokethorn	smoketree
	= *Parosela spinosa* Heller		
DASY	***Dasylirion***	**sotol**	
Date	*texanum* Scheele	Texas sotol	
Dawh	*wheeleri* Wats.	Wheeler sotol	
DODO	***Dodonaea***	**hopbush**	**hopseedbush**
Dovi	*viscosa* Jacq.	hopbush	clammy hopseed
ECHI3	***Echinocactus***	**echinocactus**	
Ecac	*acanthodes* Lem.	California barrelcactus	
	= *Ferocactus acanthodes* Britt. + Rose		
Ecco1	*covillei* (Britt. + Rose) Berger	Coville barrelcactus	
	= *Ferocactus covillei* Britt. + Rose		
Echo	*horizonthalonius* Lem.	devilshead echinocactus	
Ecjo	*johnsonii* Parry		beehive cactus
	= *Echinomastus johnsonii* Baxter		
	= *Ferocactus johnsonii* Britt. + Rose		
Ecpo1	*polyancistrus* Engelm. + Bigel.	pineapple-cactus	
	= *Sclerocactus polyancistrus* Britt. + Rose		
Ecpo	*polycephalus* Engelm. + Bigel.	cottontop echinocactus	
Ecsi	*simpsonii* Engelm.	snowballcactus	
	= *Mammillaria simpsonii* M.E. Jones		
	= *Pediocactus simpsonii* Britt. + Rose		
Ecwi	*wislizenii* Engelm.	Southwest barrelcactus	Arizona waterca
	= *Ferocactus wislizenii* Britt. + Rose		
Ecxe	*xeranthemoides* Coult.		shinyspine echinocactu

Trees and Shrubs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
ECHI2	***Echinocereus***	**echinocereus**	
Ecbo	*boyce-thompsonii* Orcutt		Boyce-Thompson echinocereus
Ecco2	*coccineus* Engelm.		
Ecen	*engelmannii* (Parry) Rumpl.	Engelmann echinocereus	
	= *Cereus engelmannii* Parry		
Ecfe	*fendleri* (Engelm.) Rumpl.	Fendler echinocereus	
Ecpe	*pectinatus* (Scheidw.) Engelm.		comb echinocereus
Ecper	*rigidissimus* Rumpl.	rainbow echinocereus	
	= *E. rigidissimus* Rose		
Ecre	*reichenbachii* (Terscheck) Hagge f.	lace echinocereus	
Ecst	*stramineus* (Engelm.) Rumpl.		strawberry echinocereus
	= *Cereus stramineus* Engelm.		
Ectr	*triglochidiatus* Engelm.	claretcup echinocereus	
Ecvi	*viridiflorus* Engelm.	greenpitaya echinocereus	
ELAE	***Elaeagnus***	**elaeagnus**	**oleaster**
Elan	*angustifolia* L.	Russianolive	
Elco1	*commutata* Bernh.	silverberry	
	= *E. argentea* Pursh		
ENCE	***Encelia***	**encelia**	**brittlebush**
Enfa	*farinosa* Gray	white brittlebush	
Enfr	*frutescens* (Gray) Gray	bush encelia	green brittlebush
EPHE	***Ephedra***	**ephedra**	**jointfir, Mormon-tea**
Epan1	*antisyphilitica* C.A. Mey.	vine ephedra	
Epne	*nevadensis* Wats.	Nevada ephedra	
Eptr	*trifurca* Torr.	longleaf ephedra	
Epvi	*viridis* Cov.	green ephedra	
ERIO	***Eriodictyon***	**yerbasanta**	
Eran2	*angustifolium* Nutt.	narrowleaf yerbasanta	mountainbalm
ERIO1	***Eriogonum* See Forbs**		
ERYT2	***Erythrina***	**coralbean**	
Erfl3	*flabelliformis* Kearney	southwestern coralbean	
EURO	***Eurotia***	**winterfat**	
Eula1	*lanata* (Pursh) Moq.	common winterfat	sweet-sage
EYSE	***Eysenhardtia***	**kidneywood**	
Eypo	*polystachya* (Ort.) Sarg.	kidneywood	
FALL	***Fallugia***	**Apacheplume**	
Fapa	*paradoxa* (D. Don) Endl.	Apacheplume	
FEND	***Fendlera***	**Fendlerbush**	
Feru2	*rupicola* Gray	cliff Fendlerbush	
Feruf	*falcata* (Thornb.) Rehd.	sickleleaf cliff fendlerbush	
FEND1	***Fendlerella***	**fendlerella**	
Feut	*utahensis* (Wats.) Heller	Utah fendlerella	
	= *Whipplea utahensis* Wats.		
FLOU	***Flourensia***	**tarbush**	
Flce	*cernua* DC.	American tarbush	tarbush

Trees and Shrubs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
FORE	***Forestiera* = *Adelia***	**forestiera**	**adelia**
Fone	*neomexicana* Gray	NewMexican forestiera	wild-olive forestiera
Fosh	*shrevei* Standl.		
FORS	***Forsellesia* = *Glossopetalon***	**greasebush**	
Fome	*meionandra* (Koehne) Heller		
Fosp1	*spinescens* (Gray) Greene = *Glossopetalon spinescens* Gray	spiny greasebush	
FOUQ	***Fouquieria***		
Fosp2	*splendens* Engelm.	ocotillo	
FRAN1	***Frankenia jamesii* Torr.**	**Frankenia**	
FRAX	***Fraxinus***	**ash**	
Fran	*anomala* Wats.	singleleaf ash	
Franl	*lowellii* (Sarg.) Little	Lowell ash	
Frcu	*cuspidata* Torr.	fragrant ash	
Frgo	*gooddingii* Little	Goodding ash	
Frpa	*papillosa* Lingelsh.	Chihuahua ash	
Frpe	*pennsylvanica* Marsh.	green ash	red ash
Frve	*velutina* Torr.	velvet ash	
FREM	***fremontia***	**fremontia**	
Frca	*californica* Torr. = *Fremontodendron californicum* Cov.	California fremontia	
GARR	***Garrya***	**silktassel**	
Gafl	*flavescens* Wats.	yellowleaf silktassel	
Gawr2	*wrightii* Torr.	Wright silktassel	
GAUL	***Gaultheria***	**wintergreen**	
Gahu	*humifusa* (Grah.) Rydb.	western wintergreen	
GOSS	***Gossypium***	**cotton**	
Goth	*thurberi* Tod. = *Thurberia thespesioides* Gray	Thurber cotton	desert cotton little cotton
GRAY	***Grayia***	**hopsage**	
Grbr	*brandegei* Gray	spineless hopsage	
Grsp	*spinosa* (Hook.) Moq.	spiny hopsage	
GUTI	***Gutierrezia* = *Xanthocephalum***	**snakeweed**	**fireweed, turpentine**
Guca	*californica* (DC.) T. + G.	California snakeweed	
Gulu	*lucida* Greene	sticky snakeweed	
Gumi	*microcephala* (DC.) Gray	threadleaf snakeweed	
Gusa	*sarothrae* (Pursh) Britt. + Rusby = *G. juncea* Greene = *G. longifolia* Greene	broom snakeweed	
HAPL	***Haplopappus* See forbs**		
HIBI	***Hibiscus***	**hibiscus, rosemallow**	**rosemallow hib**
Hico	*coulteri* Harv.	desert rosemallow	desert hibiscus
Hide	*denudatus* Benth.	paleface rosemallow	paleface hibisc
HOLA	***Holacantha***	**holacantha**	
Hoem	*emoryi* Gray	holacantha	crucifixion-tho
HOLO	***Holodiscus* = *Schizonotus*; *Sericotheca*, *Spiraea*, in part**	**rockspirea**	

Trees and Shrubs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Hodi	*discolor* (Pursh) Maxim.	creambush rockspirea	
	= *Schizonotus discolor* Raf.		
	= *Sericotheca discolor* Rydb.		
	= *Spiraea discolor* Pursh		
Hodu	*dumosus* (Nutt.) Heller	bush rockspirea	rockspirea, ocean-spray
	= *H. discolor* var. *dumosa* Dippel		
	= *Sericotheca dumosa* Rydb.		
	= *Spiraea dumosa* T. + G.		
HYME3	***Hymenoclea***	**burrobrush**	
Hymo	*monogyra* T. + G.	singlewhorl burrobrush	
Hysa	*salsola* T. + G.	white burrobrush	
HYPT	***Hyptis***	**bushmint**	**brushmint**
Hyem	*emoryi* Torr.	Emory bushmint	desertlavender
INDI	***Indigofera***	**indigo**	
Insp	*sphaerocarpa* Gray	Sonora indigo	
JACO	***Jacobinia***	**jacobinia**	
Jaov	*ovata* Gray	redfunnel jacobinia	redfunnel
JAME	***Jamesia* = *Edwinia***	**jamesia**	
Jaam	*americana* T. + G.	cliff jamesia	cliffbush
	= *Edwinia americana* Heller		
JANU	***Janusia***	**janusia**	
Jagr	*gracilis* Gray	slender janusia	
JATR	***Jatropha***	**nettlespurge**	
Jaca	*cardiophylla* (Torr.) Muell. Arg.	sangre-de-Cristo nettlespurge	sangre-de-Cristo
JUGL	***Juglans***	**walnut**	
Juma	*major* (Torr.) Heller	Arizona walnut	Arizona black walnut
Jumi	*microcarpa* Berl.	little walnut	Texas black walnut
JUNI	***Juniperus***	**juniper**	
Juco	*communis* L.	common juniper	dwarf juniper
Jucos	*saxatilis* Pall.	mountain common juniper	
	= *J. sibirica* Burgsd.		
Jude	*deppeana* Steud.	alligator juniper	
Juho	*horizontalis* Moench	creeping juniper	
	= *J. sabina* of some authors		
	= *Sabina horizontalis* Rydb.		
Jumo	*monosperma* (Engelm.) Sarg.	one-seed juniper	
Juos	*osteosperma* (Torr.) Little	Utah juniper	
	= *J. californica* var. *utahensis* Engelm.		
	= *J. knightii* A. Nels.		
	= *J. utahensis* Lemm.		
Jusc	*scopulorum* Sarg.	Rocky Mountain juniper	
KALM	***Kalmia***	**kalmia**	
Kapo	*polifolia* Wang.	bog kalmia	
	= *K. glauca* Ait.		
	= *K. occidentalis* Small		
Kapom	*microphylla* (Hook.) Rehd.	alpine bog kalmia	
	= *K. microphylla* Heller		
KOCH	***Kochia* See also under FORBS**	**summercypress**	**mock-cypress**

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Koam	*americana* Wats.	greenmolly summercypress	greenmolly, red sage
	= *K. vestita* Rydb.		
KOEB	***Koeberlinia***	**allthorn**	
Kosp	*spinosa* Zucc.	allthorn	crown-of-thorns
KRAM	***Krameria***	**krameria**	**ratany**
Krgr	*grayi* Rose + Painter	Grays krameria	
Krpa	*parvifolia* Benth.	littleleaf krameria	
LANT	***Lantana***	**lantana**	
LARR	***Larrea = Covillea***	**creosotebush**	
Latr	*tridentata* (DC.) Cov.	Coville creosotebush	creosotebush
	= *Covillea tridentata* Vail		
LEDU	***Ledum***	**Ledum**	**Labrador tea**
Legl	*glandulosum* Nutt.	Western ledum	glandular Labrad tea
LEMA	***Lemaireocereus***		
Leth	*thurberi* (Engelm.) Britt. + Rose	organpipe cactus	
	= *cereus thurberi* Engelm.		
LEPI	***Lepidium***	**pepperweed**	
Lefr	*fremontii* Wats.	desert pepperweed	
LEPT1	***Leptodactylon***		
Lepu	*pungens* (Torr.) Nutt.	granite gilia	shrubby-phlox
	= *Gilia pungens* Benth.		
LINN	***Linnaea***	**twinflower**	
Libo	*borealis* L.		
LONI	***Lonicera***	**honeysuckle**	
Loar	*arizonica* Rehd.	Arizona honeysuckle	
Loin1	*interrupta* Benth.	chaparral honeysuckle	
Loin2	*involucrata* (Richards.) Spreng.	bearberry honeysuckle	
	= *Distegia involucrata* (Richards.) Cockll.		
Loja	*japonica* Thunb.	Japanese honeysuckle	
Lout	*utahensis* Wats.	Utah honeysuckle	
LOPH1	***Lophocereus***		
Losc	*schottii* (Engelm.) Britt. + Rose		sinita
	= *Cereus schottii* Engelm.		
LOPH	***Lophophora***	**peyote**	
LYCI	***Lycium***	**wolfberry**	**desertthorn**
Lyan	*andersonii* Gray	Anderson wolfberry	
Lyco	*cooperi* Gray	Cooper wolfberry	
Lyfr	*fremontii* Gray	Fremont wolfberry	
Lypa1	*pallidum* Miers	pale wolfberry	
Lypa2	*parishii* Gray	Parish wolfberry	
Lyto	*torreyi* Gray	Torrey wolfberry	
LYSI2	***Lysiloma***	**lysiloma**	
MAMM	***Mammillaria* = *Coryphantha*, in part**	**mammillaria**	
Mafa	*fasciculata* Engelm.		little fishhook mammillaria
Mahe	*heyderi* Muehlenpfordt	Heyder mammillaria	
Mama2	*macdougalii* Rose	MacDougal mammillaria	

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Mami	*microcarpa* Engelm.	fishhook mammillaria	
Maol	*oliviae* Orcutt	Olivia mammillaria	
Mawi	*wilcoxii* Toumey	Wilcox mammillaria	
MENO	***Menodora***	**menodora**	
Mesc1	*scabra* Gray	rough menodora	
Mesc2	*scoparia* Engelm.	broom menodora	
Mesp2	*spinescens* Gray	spiny menodora	
MIMO	***Mimosa***	**mimosa**	**sensitiveplant**[85]
Mibi3	*biuncifera* Benth.	catclaw mimosa	wait-a-bit
Midy	*dysocarpa* Benth.	velvetpod mimosa	
MORT	***Mortonia***	**mortonia**	
Mosc	*scabrella* Gray		scurfy mortonia
MORU	***Morus***	**mulberry**	
Momi	*microphylla* Buckl.	Texas mulberry	
NICO	***Nicotiana*** **See also under FORBS**	**tobacco**	
Nigl	*glauca* Grah.	tree tobacco	
NOLI	***Nolina***	**nolina**	**beargrass**[86]
Nomi	*microcarpa* Wats.	sacahuista	
Note	*texana* Wats.	Texas nolina	Texas beargrass
OLNE	***Olneya***		
Olte	*tesota* Gray	tesota	ironwood[87]
OPUN	***Opuntia***	**pricklypear [flatstemmed species], cholla [roundstemmed species]**	
Opac	*acanthocarpa* Engelm. + Bigel.	buckhorn cholla	
Opar	*arbuscula* Engelm. + Bigel.		pencil cholla
Opba	*basilaris* Engelm. + Bigel.	beavertail pricklypear	beavertail cactus
Opbi	*bigelovii* Engelm.	Arizona jumping pricklypear	jumping cholla
Opch	*chlorotica* Engelm. + Bigel.	dollarjoint pricklypear	pancakepear cactus
Opec	*echinocarpa* Engelm. + Bigel.	strawtop pricklypear	strawtop
Open	*engelmannii* Salm-Dyck	Engelmann pricklypear	
Oper	*erinacea* Engelm. + Bigel.		grizzlybear pricklypear
Opfr	*fragilis* (Nutt.) Haw.	brittle pricklypear	
Opfu	*fulgida* Engelm.	jumping cholla	cholla, canecactus
Ophu	*humifusa* Raf. = *O. vulgaris* of some manuals	common pricklypear	
Opla	*laevis* Coult.	smooth pricklypear	spineless cactus
Ople	*leptocaulis* DC.	tesajo	Christmas cactus[88]
Oppa	*parishii* Orcutt	Parish cholla	
Oppo	*polyacantha* Haw. = *O. missouriensis* DC.	plains pricklypear	
Opra	*ramosissima* Engelm.	Holycross cholla	

[85] Sensitive plant is accepted common name for *Mimosa pudica.*

[86] Beargrass is the accepted common name for *Xerophyllum.*

[87] Ironwood has been applied to so many different species and genera that it is not a distinctive common name.

[88] This is a well-established name for *Zygocactus truncatus*, which blooms at Christmas.

Trees and Shrubs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Opsa	*santa-rita* (Griffiths + Hare) Rose	SantaRita pricklypear	Santa Rita cactu
	= *O. gosseliniana* var. *santa-rita* Benson		
	= *O. chlorotica* var. *santa-rita* Griffiths + Hare		
Opst	*stanlyi* Engelm.	Stanly cholla	
Opte	*tetracantha* Toumey	fourspine cholla	
	= *O. arbuscula* Engelm.		
Opve	*versicolor* Engelm.		deerhorn cholla
Opwh	*whipplei* Engelm. + Bigel.	Whipple cholla	
OSTR	***Ostrya***	**hophornbeam**	
Oskn	*knowltonii* Cov.	Knowlton hophornbeam	
Osvi	*virginiana* (Mill.) K. Koch	eastern hophornbeam	American hophornbea
OXYT1	***Oxytenia***	**oxytenia**	
Oxac	*acerosa* Nutt.	prickly oxytenia	
PACH	***Pachistima***	**pachistima**	**boxleaf**
Pamy	*myrsinites* (Pursh) Raf.	myrtle pachistima	myrtle box leaf, mountain-lo
PARK	***Parkinsonia***	**parkinsonia**	
Paac	*aculeata* L.	Jerusaleum-thorn	horsebean
PART1	***Parthenium***	**parthenium**	**rubberbush**
Paar1	*argentatum* Gray	guayule parthenium	guayule
Pain1	*incanum* H.B.K.	mariola parthenium	mariola
PART2	***Parthenocissus***	**creeper**	
Pain2	*inserta* (Kerner) K. Fritsch	thicket creeper	
	= *Parthenocissus vitacea* Hitchc.		
Paqu	*quinquefolia* (L.) Planch.	Virginia creeper	
PENI	***Peniocereus***		
Pegr2	*greggii* (Engelm.) Britt. + Rose	deerhorncactus	nightblooming-ce
	= *Cereus greggii* Engelm.		
PENS	***Penstemon*** **See also under FORBS**		
Pemi2	*microphyllus* Gray	littleleaf penstemon	
	= *P. antirrhinoides* ssp. *microphyllus* Keck		
PERA	***Peraphyllum***	**squawapple**	
Pera2	*ramosissimum* Nutt.	squawapple	
PETR	***Petrophytum***	**rockmat**	
Peca3	*caespitosum* (Nutt.) Rydb.	tufted rockmat	
	= *Spiraea caespitosa* Nutt.		
PHIL2	***Philadelphus***	**mockorange**	
Phmi	*microphyllus* Gray	littleleaf mockorange	
Phmio	*occidentalis* (A. Nels.) Hitchc. (ssp.)		
	= *P. occidentalis* A. Nels.		
PHOR	***Phoradendron***	**mistletoe**	
Phca4	*californicum* Nutt.	mesquite mistletoe	
Phju	*juniperinum* Engelm.	juniper mistletoe	
Phto	*tomemtosum* (DC.) Gray		

[89] Nightblooming-cereus is the accepted common name for the genus *Hylocereus*.

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
Phtom	*macrophyllum* (Engelm.) Weins (ssp.)	bigleaf mistletoe	
	= *P. flavescens* var. *macrophyllum* Engelm.		
PHYL	***Phyllodoce***	**mountainheath**	
Phem	*empetriformis* (Sw.) D. Don	red mountainheath	
PHYS2	***Physocarpus* = *Opulaster***	**ninebark**	
Phma	*malvaceus* (Greene) Kuntze	mallow ninebark	
	= *Opulaster malvaceus* Kuntze		
	= *Physocarpus pauciflorus* Piper		
Phmo	*monogynus* (Torr.) Coult.	mountain ninebark	
	= *Opulaster monogynus* Kuntze		
Phop	*opulifolius* (L.) Maxim		
Phopi	*intermedius* (Rydb.) Robins.		
	= *P. intermedius* Schneid.		
PICE	***Picea***	**spruce**	
Pien1	*engelmannii* Parry	Engelmann spruce	
Pigl	*glauca* (Moench) Voss	white spruce	Black Hills white spruce
Pipu	*pungens* Engelm.	blue spruce	Colorado spruce
PINU	***Pinus***	**pine**	
Pial	*albicaulis* Engelm.	whitebark pine	
Piar	*aristata* Engelm.	bristlecone pine	
Pice	*cembroides* Zucc.	Mexican pinyon	
Pico	*contorta* Dougl.	lodgepole pine	
Picol	*latifolia* Engelm.		
Pied	*edulis* Engelm.	pinyon	Colorado pinyon pine
	= *P. cembroides* var. *edulis* Voss		
Pien2	*engelmannii* Carr.	Apache pine	
Pifl	*flexilis* James	limber pine	
Piflr	*reflexa* Engelm.		Mexican white pine
Pile	*leiophylla* Schiede + Deppe		
Pilec	*chihuahuana* (Engelm.) Shaw	chihuahua pine	
Pimo	*monophylla* Torr. + Frem.	singleleaf pinyon	
Pipo	*ponderosa* Laws.	ponderosa pine	western yellow pine
Pipoa	*arizonica* (Engelm.) Shaw	Arizona pine	
PLAT2	***Platanus***	**sycamore**	
Plwr	*wrightii* Wats.	Arizona sycamore	
PLUC	***Pluchea* See also under FORBS**	**pluchea**	**marsh-fleabane**
Plse	*sericea* (Nutt.) Cov.	arrowweed pluchea	arrowweed
	= *Tessaria sericea* Shinners		
POPU	***Populus***	**cottonwood, popular**	**aspen**
Poac1	*acuminata* Rydb.	lanceleaf cottonwood	lanceleaf poplar
	= *P. andrewsii* Sarg.		
Poan3	*angustifolia* James	narrowleaf cottonwood	narrowleaf poplar
	= *P. balsamifera* var. *angustifolia* Wats.		
	= *P. fortissima* Nels. + Macbr.		
Pode1	*deltoides* Bartr.	eastern cottonwood	eastern poplar
Pofr2	*fremontii* Wats.	Fremont cottonwood	Fremont poplar
Pofrw	*wislizenii* Wats.	Rio Grande cottonwood	
Posa	*sargentii* Dode	plains cottonwood	plains poplar
	= *P. deltoides* var. *occidentalis* Rydb.		

Trees and Shrubs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Potr1	*tremuloides* Michx.	quaking aspen	
	= *P. aurea* Tidest.		
	= *P. tremuloides* var. *aurea* (Tidest.) Daniels		
	= *P. cercidiphylla* Britt.		
Potr3	*trichocarpa* Hook.	black cottonwood	California poplar
POTE	***Potentilla*** **See also under FORBS**	**cinquefoil**	
Pofr1	*fruticosa* L.	shrubby cinquefoil	bush cinquefoil
	- *Dasiphora fruticosa* Rydb.		
PROS	***Prosopis***	**mesquite**	
Prju	*juliflora* (Sw.) DC.	mesquite	common mesquit
Prjug	*glandulosa* (Torr.) Cockll.	honey mesquite	
Prjut	*torreyana* Benson	western honey mesquite	
Prjuv	*velutina* (Woot.) Sarg.	velvet mesquite	
Prpu	*pubescens* Benth.	screwbean mesquite	
	= *Strombocarpa pubescens* Gray		
PRUN	***Prunus = Cerasus = Padus***	**cherry, plum**	
Pram	*americana* Marsh.	American plum	red plum
Prbe	*besseyi* Bailey	Bessey plum	Bessey cherry
	= *P. pumila* var. *besseyi* Waugh		
Prem	*emarginata* (Dougl.) Walp.	bitter cherry	
	= *Cerasus emarginata* Hook.		
Prpa1	*padus* L.	European birdcherry	wild cherry
Prpe	*pensylvanica* L. f.	pin cherry	
	= *Cerasus pensylvanica* Lois.		
Prse	*serotina* Ehrh.	black cherry	rum cherry
Prser	*rufula* (Woot. + Standl.) McVaugh	southwestern black cherry	Gila chokecherr
Prvi	*virginiana* L.	common chokecherry	
Prvid	*demissa* (Nutt.) Torr.	western common chokecherry	
	= *P. demissa* Walp.		
Prvim	*melanocarpa* (A. Nels.) Sarg.	black common chokecherry	
	= *P. demissa* var. *melanocarpa* A. Nels.		
	= *P. melanocarpa* Rydb.		
PSEU1	***Pseudotsuga***	**Douglas-fir**	
Psme	*menziesii* (Mirb.) Franco	Douglas-fir	Common Dougl
	= *P. douglasii* Carr.		
	= *P. mucronata* Sudw.		
	= *P. taxifolia* Britt.		
Psmeg	*glauca* (Beissn.) Franco	RockyMountain Douglas-fir	
PTEL	***Ptelea***	**hoptree**	
Pttr	*trifoliata* L.	hoptree	
Pttra	*angustifolia* (Benth.) M.E. Jones	narrowleaf hoptree	
Pttrt	*trifoliata*	Baldwin hoptree	
	= *P. baldwinii* T. + G.		
Pttrp	*pallida* V. Bailey	pale hoptree	
	= *P. pallida* Greene		
PURS	***Purshia = Kunzia***	**bitterbrush**	
Putr	*tridentata* (Pursh) DC.	antelope bitterbrush	bitterbrush
	= *Kunzia tridentata* Spreng.		antelope bitterbrush
QUFR	***Quercus***	**oak**	
Quar	*arizonica* Sarg.	Arizona white oak	

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
Quch	*chrysolepis* Liebm.	canyon live oak	
Quchp	*palmeri* (Engelm.) Sarg.	Palmer oak	
Quem	*emoryi* Torr.	Emory oak	
Quga	*gambelii* Nutt.	Gambel oak	shin oak, scrub oak
	= *Q. gunnisonii* Rydb.	Gunnison oak	
	= *Q. novomexicana* Rydb.	NewMexican oak	
	= *Q. nitescens* Rydb.		
	= *Q. utahensis* Rydb.	Utah white oak	
	= *Q. vreelandii* Rydb.	Vreeland oak	
Qugr	*grisea* Liebm.	gray oak	
Quha	*havardii* Rydb.	Havard oak	
Quhy	*hypoleucoides* A. Camus	silverleaf oak	
Quma	*macrocarpa* Michx.	bur oak	
Qumu	*muhlenbergii* Engelm.	chinkapin oak	
Quob	*oblongifolia* Torr.	Mexican blue oak	
Quor	*organensis* Trel.	Organ Mountains oak	
Qupu	*pungens* Liebm.	sandpaper oak	
Qure	*reticulata* Humb. + Bonpl.	netleaf oak	
Quto	*toumeyi* Sarg.	Toumey oak	
Qutu	*turbinella* Greene	shrub live oak	
Quun	*undulata* Torr.	wavyleaf oak	scrub oak
RHAM	***Rhamnus***	**buckthorn**	
Rhal1	*alnifolia* L'Her.	alder buckthorn	
Rhbe	*betulaefolia* Greene	birchleaf buckthorn	
Rhca	*californica* Esch.	California buckthorn	coffeeberry
Rhcr	*crocea* Nutt.	hollyleaf buckthorn	redberry buckthorn
Rhsm	*smithii* Greene	Smith buckthorn	
RHOD	***Rhododendron = Azalea = Azaleastrum***	**rhododendron**	
Rhal	*albiflorum* Hook.	Cascades azalea	
	= *Azalea albiflora* Kuntze		
	= *Azaleastrum albiflorum* Rydb.		
RHUS	***Rhus = Toxicodendron,* in part**	**sumac**	
Rhch	*choriophylla* Woot. + Standl.	Mearns sumac	
Rhgl	*glabra* L.	smooth sumac	
	= *schmaltzia glabra* Small		
Rhglc	*cismontana* (Greene) Daniels	RockyMountain smooth sumac	
	= *R. cismontana* Greene		
Rhke	*kearneyi* Barkley	Kearney sumac	
Rhla	*lanceolata* (Gray) Britt.	prairie sumac	
Rhov	*ovata* Wats.	sugar sumac	mountain-laurel
Rhra	*radicans* L.	common poison-ivy	
	= *Toxicodendron radicans* Kuntze		
Rhrar	*rydbergii* (Small) Rehd.	western poison ivy	
	= *Toxicodendron radicans* var. *rydbergii* Erskine		
Rhtr	*trilobata* Nutt.	skunkbush sumac	skunkbush squawberry
	= *Schmaltzia trilobata* Small		
RIBE	***Ribes = Grossularia***	**gooseberry, currant**	
Riam	*americanum* Mill.	American black currant	
Riau	*aureum* Pursh	golden currant	
Rice	*cereum* Dougl.	wax currant	
Rico1	*coloradense* Cov.	Colorado currant	
Riin1	*inebrians* Lindl.	squaw currant	
	= *R. cereum* var. *inebrians* (Lindl.) C. L. Hitchc.		

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES ACCEPTED	OTHER
Riin2	*inerme* Rydb.	whitestem gooseberry	
	= *Grossularia inermis* Cov. + Britt.		
Rila	*lacustre* (Pers.) Poir.	prickly currant	swamp currant
Rime	*mescalerium* Cov.[90]	mescalero currant	
Rimo	*montigenum* McClat.	gooseberry currant	
	= *R. nubigenum* McClat.		
Ripe	*petiolare* Dougl.	western black currant	
	= *R. hudsonianum* Richards.		
	= *R. hudsonianum* var. *petiolare* Jancz.		
Ripi	*pinetorum* Greene	orange gooseberry	
Riqu	*quercetorum* Greene	oakwoods gooseberry	
Rise	*setosum* Lindl.	redshoot gooseberry	
	= *R. saximontanum* E. Nels.		
	= *Grossularia setosa* Cov. + Britt.		
Ritr	*triste* Pall.	American red currant	
	= *R. albinervium* Michx.		
	= *R. ciliosum* Howell		
Rive	*velutinum* Greene	desert gooseberry	
Rivi	*viscosissimum* Pursh	sticky currant	
Rivih	*hallii* Jancz.	Halls currant[91]	
	= *R. hallii* Jancz.		
Riwo	*wolfii* Rothrock	Rothrock currant	
RICI	***Ricinus***		
Rico	*communis* L.	castor-bean	
ROBI	***Robinia***	**locust**	
Rone1	*neomexicana* Gray	NewMexico locust	
Rops	*pseudo-Acacia* L.	black locust	
ROSA	***Rosa***	**rose**	
Roac	*acicularis* Lindl.	prickly rose	
	= *R. sayi* Schwein.		
Roar	*arizonica* Rydb.		Arizona rose
Roar2	*arkansana* Porter	Arkansas rose	
Ronu	*nutkana* Presl	Nootka rose	
	= *R. manca* Greene	Mancos rose	
	= *R. oreophila* Rydb.		
	= *R. oreophila* Rydb.	Spalding rose	Spalding rose
	= *R. spaldingii* Crepin		
Rost	*stellata* Wooton	desert rose	
Rowo	*woodsii* Lindl.	Woods rose	
	= *R. fendleri* Crepin	Fendler Woods rose	
	= *R. maximiliana* Nees		
	= *R. neomexicana* Cockll.	NewMexico rose	
	= *R. sandbergii* Greene		
RUBU	***Rubus***	**blackberry, dewberry, rasberry**	
Ruar	*arizonensis* Focke		Arizona dewbe
Rude	*deliciosus* Torr.	boulder raspberry	
Ruid	*idaeus* L.	red raspberry	
Rule	*leucodermis* T. + G.	whitebark raspberry	

[90] Very closely related to squaw currant; probably not in Colorado or Wyoming; found in the White and Sacramento Mountains of New Mexico, and West Texas.

[91] Probably not in our area; a shrub of northern California, southern Oregon and western Nevada.

Trees and Shrubs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Rune	*neomexicanus* Gray	NewMexican raspberry	
Rupa	*parviflorus* Nutt.	western thimbleberry	
	= *Bossekia parviflora* Greene		
	= *R. nutkanus* Ser.		
Rupr	*procerus* Muell.	Himalaya blackberry	
Rust	*strigosus* Michx.	American red raspberry	red raspberry
	= *R. idaeus* var. *strigosus* Maxim.		
SALI	***Salix***	**willow**	
Saal	*alba* L.	white willow, yellowstem white willow	
Saam	*amygdaloides* Anderss.	peachleaf willow	
Saar1	*arctica* Pall.	Arctic willow	
	= *S. anglorum* Cham.		
Sabe	*bebbiana* Sarg.	Bebb willow	beaked willow
	= *S. rostrata* Richards.		
Sabep	*perrostrata* (Rydb.) Fern.	smooth Bebb willow	
	= *S. perrostrata* Rydb.		
Sabo	*bonplandiana* H.B.K.	Bonpland willow	
Sabr1	*brachycarpa* Nutt.	barrenground willow	
Saca	*cascadensis* Cockll.	Cascade willow	
Sadi	*discolor* Muhl.	pussy willow	
Sadr	*drummondiana* Barratt	Drummond willow	
Sadrs	*subcoerulea* Ball.	blue willow	
	= *S. subcoerulea* Piper		
Saer	*eriocephala* Michx.	Missouri River willow	
	= *S. cordata* Muhl.		
Saex	*exigua* Nutt.	coyote willow	
Sage	*geyeriana* Anderss.	Geyer willow	silver willow
Sagl1	*glauca* L.	grayleaf willow	
	= *S. glaucops* Anderss.		
	= *S. pseudolapponum* von Seem.		
Sago	*gooddingii* Ball	Goodding willow	black willow
Sain	*interior* Rowlee	sandbar willow	
	= *S. exigua* ssp. *interior* Cronq.		
	= *S. longifolia* Muhl.		
Sala1	*laevigata* Bebb	red willow	polished willow
Sala2	*lasiandra* Benth.	Pacific willow	
Salal	*lasiandra*		
	= *S. fendleriana* Anderss.		
Salac	*caudata* (Nutt.) Sudw.		
	= *S. caudata* Heller		
Sala3	*lasiolepis* Benth.	arroyo willow	white willow
Salu	*lutea* Nutt.	yellow willow	
	= *S. rigida* Muhl.		
Salul	*ligulifolia* Ball	strapleaf willow	
	= *S. ligulifolia* (Ball) Ball		
Samo1	*monticola* Bebb		mountain willow
	= *S. padophylla* Rydb.	serviceberry willow	
	= *S. pseudomonticola* Ball		
Sani	*nivalis* Hook.	snow willow	
Sanis	*saximontana* (Rydb.) Schneid.	summit willow	
	= *S. saximontana* Rydb.		
Sano	*novae-angliae* Anderss.	tall blueberry willow	
	= *S. myrtillifolia* Anderss.		
	= *S. pseudomyrsinites* Anderss.		

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Sanop	*pseudocordata* Anderss. = *S. pseudocordata* Anderss.		
Sape	*pentandra* L.	laurel willow	
Sape1	*petiolaris* J.E. Sm.	meadow willow	
Sapl	*planifolia* Pursh = *S. phylicifolia* ssp. *planifolia* (Pursh) Hiitonen var. *planifolia*	planeleaf willow	
Saplm	*monica* (Bebb) Schneid. = *S. phylicifolia* var *monica* Jeps.	Mono planeleaf willow	
Sapln	*nelsonii* E.C. Sm. = *S. nelsonii* Ball	Nelson planeleaf willow	
Sasc	*scouleriana* Barratt	Scouler willow	mountain willow
Sata	*taxifolia* H.B.K.	yewleaf willow	
Satw	*tweedyi* (Bebb) Ball = *S. barrattiana* var. *tweedyi* Bebb	Tweedy willow	
Sawo	*wolfii* Bebb	Wolfs willow	
SALV	***Salvia*** **See also under FORBS**	**sage**	
Sado	*dorrii* (Kell.) Abrams	desert sage	
Sadoc	*carnosa* (Dougl.) Cronq. = *S. carnosa* Benth.		
Samo	*mohavensis* Greene	Mohave sage	
Sapi	*pinguifolia* (Fern.) Woot.+ Standl.		
SAMB	***Sambucus***	**elder**	
Sace1	*cerulea* Raf. = *S. glauca* Nutt.	blueberry elder	
Same1	*melanocarpa* Gray = *S. racemosa* var. *melanocarpa* McMinn	blackbead elder	
Same2	*mexicana* Presl	Mexican elder	
Sapu	*pubens* Michx. = *S. racemosa* var. *pubens* Koehne	scarlet elder	
Sara	*racemosa* L.		
Saram	*microbotrys* (Rydb.) K. + P.	bunchberry elder	
Save1	*velutina* Dur. + Hilg.	velvet elder	
SAPI	***Sapindus***	**soapberry**	
Sapa	*saponaria* L.	western soapberry	
Sapad	*drummondii* (H. + A.) Benson = *S. drummondii* H. + A.		
SAPI2	***Sapium***	**sapium**	
Sabi	*biloculare* (Wats.) Pax	jumping-bean sapium	
SARC	***Sarcobatus***	**greasewood**	
Save2	*vermiculatus* (Hook.) Torr.	black greasewood	
SHEP	***Shepherdia***	**buffaloberry**	
Shar	*argentea* (Pursh) Nutt. = *Lepargyraea argentea* Greene	silver buffaloberry	
Shca	*canadensis* (L.) Nutt. = *Lepargyraea canadensis* Greene	russet buffaloberry	
Shro	*rotundifolia* Parry	roundleaf buffaloberry	
SIMM	***Simmondsia***	**jojoba**	
Sich	*chinensis* (Link) Schneid.	California jojoba	
SOPH	***Sophora*** **See also under FORBS**	**sophora**	
Soar	*arizonica* Wats.	Arizona sophora	

Trees and Shrubs (continued)

SYMBOL	SCIENTIFIC NAME	COMMON NAMES	
		ACCEPTED	OTHER
Sonu1	*nuttalliana* B. Turn. = *S. sericea* Nutt.	silky sophora	
Sose1	*secundiflora* (Ortega) Lag.	mescalbean	
Sost	*stenophylla* Gray	fringeleaf sophora	
SORB	***Sorbus***	**mountain-ash**	
Soau	*aucuparia* L. = *Pyrus aucuparia* Gaertn.	European mountain-ash	
Sodu	*dumosa* Greene	Arizona mountain-ash	
Sosc	*scopulina* Greene	Greenes mountain-ash	
SPIR1	***Spiraea***	**spirea**	
Splu	*lucida* Hook. = *S. betulifolia* (Hook.) C. L. Hitchc.	shinyleaf spirea	
SYMP	***Symphoricarpos***	**snowberry [white fruited species], coralberry [red fruited species]**	
Syal	*albus* (L.) Blake = *S. pauciflorus* Britt. = *S. racemosus* Michx. = *S. rivularis* Suksd.	common snowberry	
Sylo	*longiflorus* Gray	longflower snowberry	
Syoc	*occidentalis* Hook.	western snowberry	
Syor	*orbiculatus* Moench	Indiancurrant coralberry	Indian coralberry
Syor1	*oreophilus* Gray = *S. vaccinioides* Rydb.	mountain serviceberry, whortleleaf snowberry	
Syoru	*utahensis* (Rydb.) A. Nels. = *S. utahensis* Rydb.	Utah snowberry	
Syro1	*rotundifolius* Gray	roundleaf snowberry	
TAMA	***Tamarix***	**tamarisk**	
Tapa	*parviflora* DC.	tamarisk	saltcedar
Tara	*ramosissima* Ledeb.	tamarisk	saltcedar
TECO	***Tecoma* = *Stenolobium***	**yellowtrumpet**	
Test	*stans* (L.) Juss. = *Stenolobium incisum* Rose + Standl.	Florida yellowtrumpet	trumpetbush
TETR	***Tetradymia***	**horsebrush**	
Teca	*canescens* DC.	gray horsebrush	
Tecai	*inermis* (Nutt.) Gray	spineless gray horsebrush	
Tesp	*spinosa* H. + A.	cottonthorn horsebrush	
THAM	***Thamnosma***	**desertrue**	
Thmo2	*montana* Torr. + Frem.	Mohave desertrue	turpentine-broom
Thte	*texana* (Gray) Torr.	Texas desertrue	
TRIX	***Trixis***	**trixis**	

Trees and Shrubs (continued)

		COMMON NAMES	
SYMBOL	SCIENTIFIC NAME	ACCEPTED	OTHER
Trca2	*californica* Kell.	American trixis	
ULMU	***Ulmus***	**elm**	
Ulam	*americana* L.	American elm	
UNGN	***Ungnadia***	**Mexicanbuckeye**	
Unsp	*speciosa* Endl.	Mexicanbuckeye	
VACC	***Vaccinium***	**blueberry, whortleberry**[92]	**farkleberry, cranberry, deerberry**
Vaca1	*caespitosum* Michx.	dwarf blueberry	
Vame	*membranaceum* Hook.	big whortleberry	
	= *V. myrtilloides* var. *macrophyllum* Hook.		
Vamy	*myrtillus* L.	RockyMountain whortleberry	
	= *V. oreophilum* Rydb.		
Vasc	*scoparium* Leiberg	grouse whortleberry	
	= *V. microphyllum* Rydb.		
	= *V. myrtillus* var. *microphyllum* Hook.		
VAUQ	***Vauquelinia***	**vauquelinia**	
Vaca	*californica* (Torr.) Sarg.	Torrey vauquelinia	Arizona-rosewo
VIBU	***Viburnum***	**viburnum**	
Vile1	*lentago* L.	nannyberry	
Viop	*opulus* L.	European cranberrybush viburnum	
Vitr	*trilobum* Marsh.	American cranberrybush viburnum	
	= *V. americanum* of some authors		
	= *V. opulus* of some authors		
	= *V. opulus* var. *americanum* Ait.		
	= *V. opulus* ssp. *trilobum* Clausen		
VITI	***Vitis***	**grape**	
Viar	*arizonica* Engelm.	canyon grape	
Vivu	*vulpina* L.	frost grape	
	= *V. cordifolia* Michx.		
WASH	***Washingtonia***	**washingtonia**	
Wafi	*filifera* (Linden) Wendl.	California washingtonia	California washington
YUCC	***Yucca***	**yucca**	**Spanish-bayon**
Yuan	*angustissima* Trel.	fineleaf yucca	
Yuba	*baccata* Torr.	datil yucca	blue yucca
Yubr	*brevifolia* Engelm.	Joshua-tree	Joshuatree yuc
Yuel	*elata* Engelm.	soaptree yucca	
Yugl	*glauca* Nutt.	small soapweed	
	= *Y. angustifolia* Pursh		
Yune	*neomexicana* Woot. + Standl.	NewMexican yucca	
	= *Y. harrimaniae* McKelvey		
Yush	*schidigera* Ortgies	Mohave yucca	
	= *Y. mohavensis* Sarg.		
Yusc	*schottii* Engelm.	Schott yucca	hoary yucca, Spanish-ba
Yuto	*torreyi* Shafer	Torrey yucca	Spanish-dagge
ZUCK	***Zuckia***		
Zuar	*arizonica* Standl.		Arizona zuckia

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[92] Species of *Vaccinium* without blue fruit.

Index of Common Names

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Nickerson, Mona F., Glen E. Brink, and Charles Feddema.
1976. Principal range plants of the central and southern Rocky Mountains: Names and symbols. USDA For. Serv. Gen. Tech. Rep. RM-20, 121 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521.

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Keywords: Plant names, grasses, grasslike plants, forbs, trees, shrubs.

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FROST HEAVING OF TREE SEEDLINGS:

A Literature Review of Causes and Possible Control

L. J. Heidmann

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General Technical Report RM-21
Rocky Mountain Forest and
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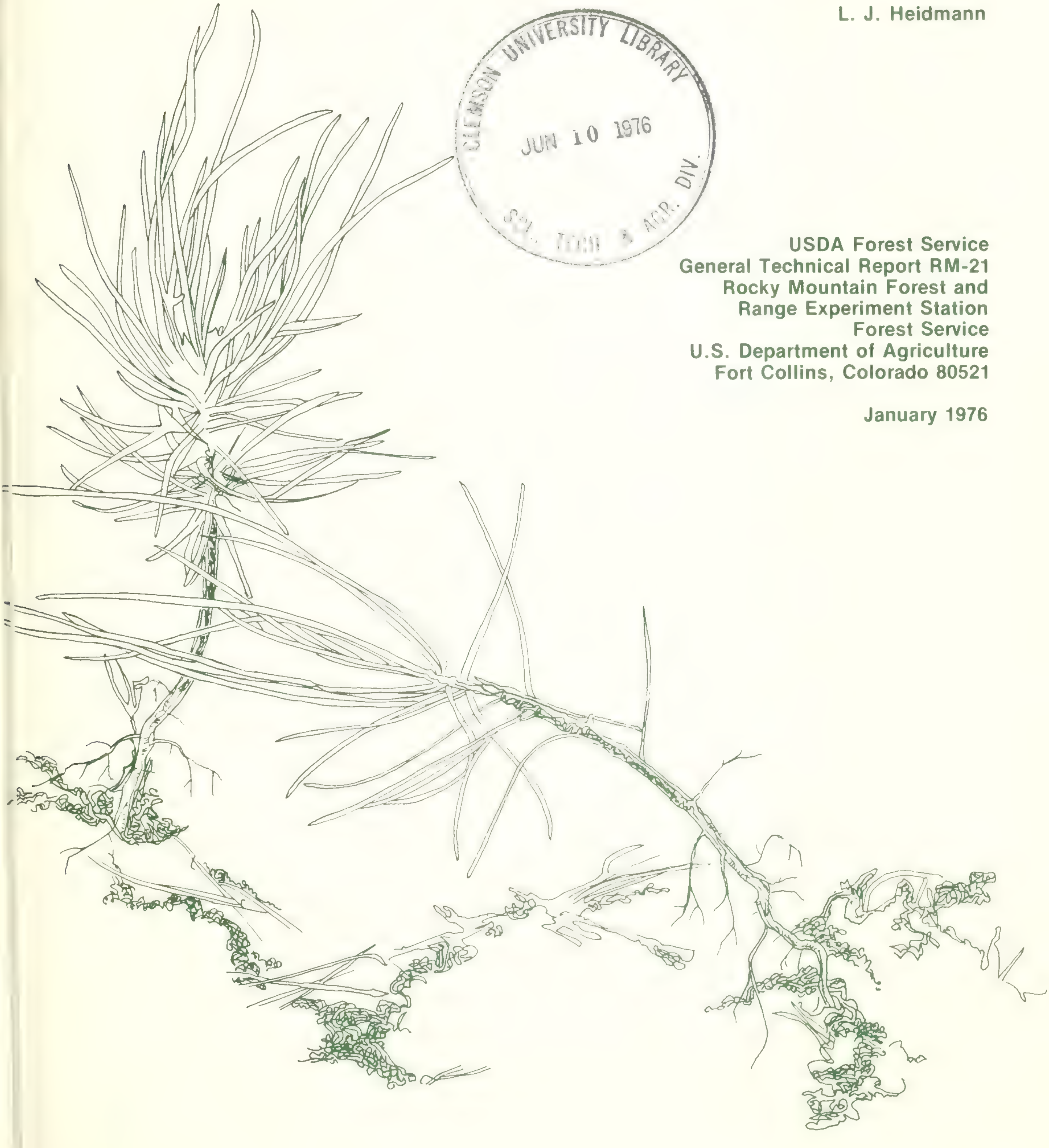
Forest Service
U.S. Department of Agriculture
Fort Collins, Colorado 80521

January 1976



Abstract

Heidmann, L. J.
1976. Frost heaving of tree seedlings: A literature review of causes and possible control. USDA For. Serv. Gen. Tech. Rep. RM-21, 10 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Frost heaving of tree seedlings is more serious among seedlings less than 1 year old than among transplanted stock. It appears to be a surface soil phenomenon, and occurs because of a segregation of soil water which freezes into layers or lenses of ice. Lens formation causes an uplift of the surface soil and the tree seedling. Upon thawing, the tree remains in an extruded position on the soil surface while the soil recedes to approximately its original level. Segregation of the soil water occurs within the total matrix because of supercooling of the water in smaller soil pores and the water adsorbed on soil particles. The difference in freezing points provides the energy necessary to draw water to the ice lens and to lift the surface. Segregation of soil water is related to soil permeability and negative pressure on the water. A silty soil is more likely to heave because the right combination of permeability and tension can be developed. Heaving in a clay soil is determined to a great extent by the type of clay and the nature of the ions adsorbed by the clay particles. Heaving can be controlled by lowering the freezing point of the soil water, by restricting the water flow to the freezing front, or by cementing the soil particles together. Chemicals such as calcium chloride have been successful in reducing frost heaving by lowering the freezing point of the soil water. Dispersing agents, mainly sodium compounds, reduce heaving by plugging the soil pores, thus limiting water movement to the freezing front and subsequent growth of ice lenses. Cementing agents make the soil less frost susceptible by reducing the proportion of finer soil particles (clay and silt).

Keywords: Frost heaving, soil water segregation, supercooling, tree seedling mortality.

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January 1976

FROST HEAVING OF TREE SEEDLINGS:
A Literature Review of Causes and Possible Control

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[1] *Central headquarters is maintained at Fort Collins, in cooperation with Colorado State University; author is located at the Station's Research Work Unit at Flagstaff, in cooperation with Northern Arizona University. Information contained in this paper is part of a Ph.D. Dissertation submitted to the University of Arizona, Tucson.*

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FROST HEAVING OF TREE SEEDLINGS: A Literature Review of Causes and Possible Control

L. J. Heidmann

INTRODUCTION

Frost heaving, one of the major causes of tree seedling mortality in many parts of the world, can occur in areas that have below-freezing temperatures, adequate soil water, and susceptible soils.

In northern Arizona, frost heaving may be the leading cause of ponderosa pine seedling mortality during the first winter. Larson (1961) found that frost heaving destroyed 52 percent of the seedlings in a seeding study during one night in October 1957. Larson (1960) noted in another study that only 5 percent of seedlings damaged by frost heaving survived compared to 20 percent for seedlings with no heaving damage.

With grass and brush seedlings, Biswell et al. (1953) frequently observed 75 percent or more mortality by frost heaving in California. Heaving was more severe on north slopes, and legumes were more affected than grasses. Heaving of legumes in Illinois is also a serious problem (Portz 1967).

In addition to plants, almost all objects in frost-susceptible soil, such as stakes, posts, poles, roads, and runways, can be moved upward by frost action (fig. 1).

Despite the fact that frost heaving is a serious problem, it has not been studied intensively by foresters or workers in other allied agricultural fields. Most of the basic information describing the heaving phenomenon is provided by engineers concerned about heaving of highways, runways, buildings, and other structures (Casagrande 1931; Beskow 1947; Grim 1952; Kersten 1952; Smith 1952; Aldrich 1956; Lambe 1956; Penner 1958, 1959; Low and Lovell 1959; Martin 1959). Work is also being done by scientists at the Cold Regions Research and Engineering Laboratory (CRREL) (Higashi 1958, Corte 1961, Chalmers and Jackson 1970, Kaplar 1971).

MECHANISM OF FROST HEAVING

Frost heaving is a phenomenon involving the surface layer of the soil (Schramm 1958, Fahey 1973, Heidmann 1974). Schramm (1958), in explaining the heaving of tree seedlings, stated that an upper layer of coarse soil freezes solid because the pores are relatively large and the water in them freezes at close to 0°C. The frozen layer grips the tree stem tightly. Below the surface layer the soil has a finer texture

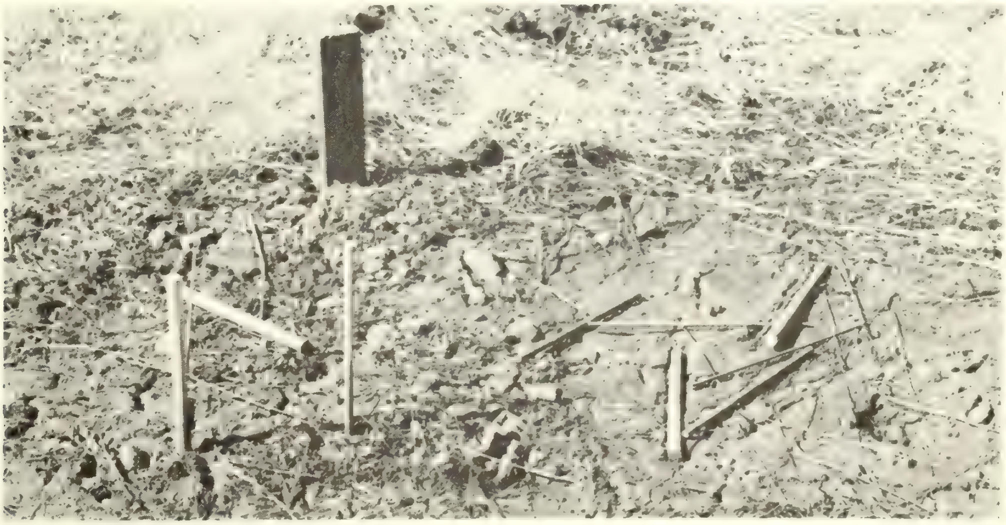

Figure 1.—Wooden dowels 0.31 to 1.27 mm in diameter. The dowels lying on soil surface heaved 10 cm in a few weeks' time.

(Corte 1961) and consequently smaller pores. The water in the smaller pores freezes at a lower temperature, resulting in a movement of water to a freezing line and formation of an ice layer. The ice layer pushes up the layer of frozen soil above, including the tree seedling. As the soil thaws, it recedes to its approximate original position, leaving the seedling extruded on the soil surface. Theoretically, only one freeze-thaw cycle is necessary for heaving to occur. In the field, however, time-lapse photography showed heaving is usually the result of a series of freeze-thaw cycles (Heidmann 1974).

An interesting facet of frost heaving as related to conifer seedlings is that on many soils heaving injury is almost exclusively confined to first-year seedlings. In Arizona, few ponderosa pine transplants (2-0 or older) heave. Haasis (1923), working near Flagstaff, noted that 98 percent of frost-heaved ponderosa pine seedlings were in their first year. Similarly, Schramm (1958) found that by October, in the coal fields of Pennsylvania, all persimmon (*Diospyros virginiana*), pine (*Pinus virginiana* and *P. rigida*), and oak (*Quercus alba, Q. bicolor,* and *Q. borealis*) seedlings which had germinated in the spring had been severed or pushed out of the soil. Not one of 400 pine transplants (*Pinus banksiana, P. strobus, P. sylvestris,* or *P. rigida*) of various ages planted on the same site the same spring showed evidence of heaving, however.

Schramm explained the differences by stating that pine transplants present a considerable surface to the wind at all times so that even gentle winds will cause the relatively stiff woody stem to sway. The swaying motion results in the stem being pushed against the wet soil and causes an air gap or ring to form between the soil and the tree stem. Subsequently when the surface soil layer freezes, it does not grip the tree stem. As a result, when the soil lifts during heaving, it rides up the stem of the tree. Deciduous seedlings, in a leafless state, do not present as large a surface area as conifers for the wind to act upon. Consequently they do not move back and forth in the wind as readily as pine transplants, and no gap is formed around the stem; thus, the frozen surface layer of soil can grip the stem and the tree heaves. Current-year pine seedlings heave because they have a much smaller aerial surface than transplants, and are probably more protected from the wind since the tops are closer to the soil surface. The stem is also more supple, so that instead of displacing the soil the stem bends at the soil surface and no gap is formed around the stem.

There are obvious differences between root systems of current-year seedlings and transplants. The transplanted seedling should have a considerably more extensive root system by the time the frost heaving season begins, which may anchor the tree. On a site where heaving of first-year seedlings is excessive, however, none of the many 2-0 ponderosa pines planted in late September on several occasions have heaved appreciably (personal observation). Roots of trees planted in September grow little if at all, and consequently there is very little anchoring of the seedling.

Schramm's (1958) explanation of heaving of tree seedlings indicates that heaving is a surface soil phenomenon, probably involving no more than the upper 2 or 3 cm. Heidmann (1974) tends to confirm this hypothesis by showing that plastic "Ontario" tubes buried as little as 10 to 15 mm below the soil surface did not heave nearly as readily as tubes planted flush with the soil surface (fig. 2). In addition, wooden dowels "planted" in the soil with gaps between the dowel and the soil surface generally heaved less than dowels planted without gaps.

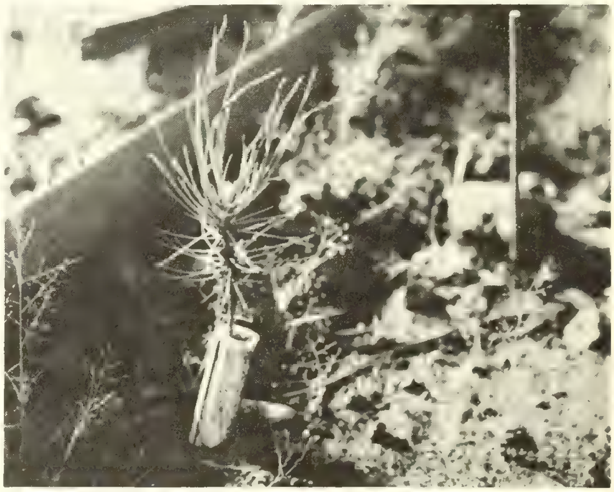

Figure 2.—Ontario tube containing a ponderosa pine seedling which did not heave completely out of the ground.

Studies by Fahey (1973) also indicate that heaving is closely related to soil surface conditions.

Factors Associated with Ice Lens Formation

Segregation of Soil Water

Early researchers suggested that frost heaving resulted from an expansion of the soil water upon freezing. Taber (1929), however, pointed out that when water freezes there is an increase in volume of only 9 percent which could not explain the degree of uplift noted in many soils. In a series of classical experiments, Taber (1929, 1930) demonstrated that frost heaving was due to a segregation of water in the soil which froze into layers of ice. The amount of uplift was generally equal to the thickness of the ice layers in the soil. The segregation of soil water is the result of a slow freezing process caused by a migration of water to a freezing front, resulting in the formation of ice lenses in the soil. This type of ice has been referred to as needle ice (fig. 3), stalactite ice, or comb ice (kammeis) (Schramm 1958).

Soons and Greenland (1970) duplicated the formation of needle ice in the laboratory. They found that ice needles 6.5 cm long were produced by the third day with an ambient temperature of -4°C. A decline of soil water in the upper layers was noted, and a second layer of needles was initiated below the first layer and separated from it by a layer of soil.

Rapid freezing of the soil causes the soil water to freeze in place in the larger pores, and produces concrete frost. The uplift of the soil is only slight with rapid freezing.

Freezing of water.—Heat is evolved from all substances in the phase change from the liquid to solid state. In the case of water, this heat is called heat of fusion or crystallization. For each gram of water that freezes, about 80 calories of heat are released. The rate of freezing and thawing in soil varies with the temperature, pressure, and shape of the ice surface (Chalmers 1959). At a given pressure there is only one temperature at which these rates are equal. When salt is added to water, the freezing point drops because of an increase in osmotic pressure and a subsequent decrease in water potential.

If no ice is present, water can be supercooled. If ice is added, freezing will occur and ice will grow rapidly until the latent heat evolved raises the temperature of the ice and water mixture to the freezing point (Chalmers 1959). The temperature of equilibrium depends on the curvature of the ice surface. For each temperature there is a critical radius of curvature at which ice and water are in equilibrium. A small ice crystal may have an equilibrium temperature below 0°C. The absence of an ice crystal with a critical radius allows water to remain liquid when it is supercooled (Chalmers 1959).

Freezing of soil water.—Water in the soil may freeze at a temperature below 0°C. According to Outcalt (1969), a wet soil surface will freeze if the surface can be supercooled to the ice nucleation temperature of about -2°C. Freezing occurs when the equilibrium temperature of the soil surface descends to the ice nucleation temperature.

To maintain the growth of clear ice needles at a point, the vertical flow of water to the freezing front must match the fusion rate. That is, 1 g of soil water must be supplied for each 80 calories of heat flowing through the needles toward the soil surface. If either the heat flow to the surface becomes too large or the supply of water becomes limiting, segregation will stop and water will freeze in the soil pores. In most instances the soil surface layer dries slightly due to evaporation. Since segregation of soil water only occurs when the soil pores are near or above saturation, the surface layer freezes solid. It is because of the drying of the surface soil layer that, at all but the

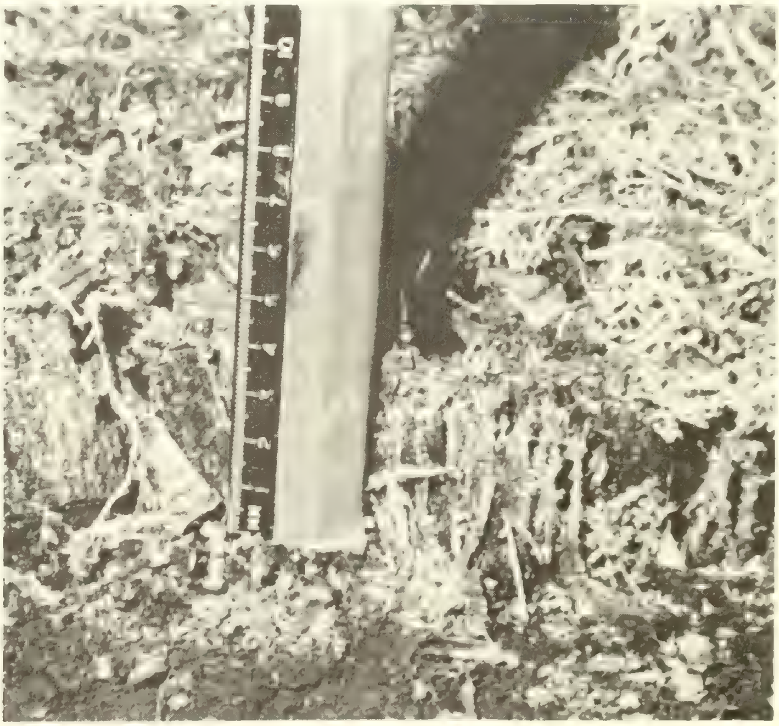

Figure 3.—Example of ice layer often referred to as needle ice. When needle ice forms on the surface of the soil (as shown), it indicates that the soil is very wet.

wettest sites, needle ice usually wears a cap of frozen soil. The base of the cap is located at exactly the level where the water flux first equaled the fusion rate (Outcalt 1969).

Supercooling of soil water.—Soil water migrates to the freezing front due to the supercooling (Taber 1929). The nucleation temperature must always be below the freezing point. In pure water this temperature may be as low as -39°C (Martin 1959). In ordinary tap water, the nucleation temperature is about -6°C (Chalmers and Jackson 1970), but in the soil it is nearer to -2°C (Outcalt 1969).

Nucleation of soil water is modified, since the water is present as separated small volumes, and the proximity of the soil-water interface lowers the temperature required to nucleate the ice. Edlefsen and Anderson (1943) demonstrated in a water-ice system that, if the pressure on the ice is constant, while the pressure on the water changes, the effect on the freezing temperature is: $dT/dP = + 0.0824$ C/atm if the pressure is positive. A negative pressure lowers the freezing point.

In the soil, the freezing point is lowered because the freezing of water lowers the water content, which creates a tension or negative pressure at the freezing zone. In addition, the cations within the double layers of the hydration shell of soil particles, mainly the clays, are excluded from the ice which raises the osmotic pressure of the remaining water, thus contributing to the negative pressure (Martin 1959).

Adsorbed water.—Water adsorbed by soil particles freezes at a lower temperature than pure water (Taber 1929, Penner 1959). In a kaolinite clay, when the ice crystal has grown to within 30 Å of the clay surface, the freezing point of the water molecules adjacent to the ice is depressed about 0.4°C below the freezing point of water at the center of the pore. When the crystal grows to within 10 Å of the surface, the freezing point is depressed about 4°C (Martin 1959).

According to Low and Lovell (1959), exchangeable ions on the soil particles appear to be involved in water adsorption. In the earliest stages of adsorption, these ions form ion-dipole bonds with the water molecules; that is, they hydrate and thereby hold water to the mineral surfaces. The mineral surfaces also attract water, probably due to hydrogen bonding between the water molecules and the $O^{=}$to OH^{-}ions on the mineral surfaces (Low and Lovell 1959).

Many authors (Taber 1929, 1930; Beskow 1947; Penner 1959; Chalmers and Jackson 1970) have pointed out the existence of a thin film of water between an ice layer and the adjacent soil particles. The water in this layer may not freeze until a temperature of -180°C is attained (Jung 1931, cited by Vershinin et al. 1960). Chalmers and Jackson (1970) stated that the layer of water between the ice and the soil particles has an equilibrium thickness. The thickness of the layer varies, and at a sufficiently low temperature it does not exist. If the soil water is supercooled, a little of the water layer separating the ice and soil will freeze, reducing the thickness of this layer below the equilibrium thickness. The equilibrium thickness can be restored by an influx of water from the unfrozen soil. A steady-state thickness of the water layer will be established, however, which is narrower than the equilibrium thickness, because as fast as water is drawn into the layer, water freezes on the ice lens. The layer of water is a region of negative pressure. The negative pressure would be eliminated by the influx of water if freezing were not continuous.

The freezing point of soil water is also related to the specific surface-to-volume ratio of ice, as demonstrated in the following equation (Chalmers and Jackson 1970):

$$\Delta T = \frac{A_i \sigma T_E}{V_i L}$$

where

ΔT = freezing point depression,
A_i = surface area of the ice structure,
σ = solid-liquid surface free energy per unit area,
T_E = 273 K,
V_i = volume of ice transformed, and
L = latent heat per unit volume.

Energy Requirements

For an ice lens to grow, water must move through the soil. This movement requires a pressure gradient, which can develop at the freezing front because of a free energy difference (Chalmers and Jackson 1970) given by:

$$P = \frac{L\Delta T}{T_E}$$

The energy required to lift the soil and draw water to the ice lens comes from the change in free energy (ΔF) (Martin 1959):

$$\Delta F = \frac{L(T_o - T_x)}{T_o}$$

where

T_o = freezing point of free water,

T_x = actual freezing point of soil water, and

L = latent heat of fusion (80 cal/g).

This equation demonstrates that, if the freezing point of water is not lowered and $T_o = T_x$, then free energy is unavailable to lift the soil or to draw water to the freezing front. The greater the difference between T_o and T_x, the more energy is available for soil movement or heaving.

For freezing to occur in place, the ice must grow between the soil particles. Such ice growth can only happen if the radius of curvature of the ice is less than the radius of the pore channels (Chalmers and Jackson 1970). Soil water will freeze in place only below the temperature given by substituting the appropriate value for r in the following equation:

$$\Delta T = \frac{2\sigma T_E}{Lr}$$

where r = radius of pore, and other symbols have the same meanings as previously defined.

Temperature Requirements

The transfer of heat within soil is important in determining if frost heaving will occur.

With the onset of freezing conditions, water in the surface soil begins to freeze, and the heat released flows upward in response to the imposed temperature gradient. Water flows to the freezing front. When the water supply to the freezing zone is adequate, the amount of heat supplied by fusion is equal to the heat lost from the soil, and the freezing front remains stationary in the soil. If the supply of water is not adequate, the amount of heat lost from the soil is greater than that released by fusion, and the freezing front will move downward into the soil. In the former situation, ice lenses develop in the soil and heaving occurs. In the latter situation, water freezes in place and heaving does not take place.

Energy can be transferred by radiation, conduction, and convection. In the case of soil, the heat is transferred by conduction only unless water is moving within the soil voids (Aldrich 1956). The concept of heat conductivity describes a transfer of kinetic energy from the molecules of a warm particle to a cooler particle. The rate at which this heat is transferred is given by:

$$Q = K\frac{V_1 - V_2}{l}A$$

where

Q = rate of heat flow,

$V_1 - V_2$ = temperature difference,

l = length,

A = cross-sectional area, and

K = coefficient of thermal conductivity.

The coefficient of thermal conductivity (K) is a measure of the quantity of heat that will pass through a unit area of unit thickness in unit time under a unit temperature gradient. The K of the soil depends on its density, water content, temperature, texture, structure, and mineral composition (Kersten 1952).

The rate of frost heaving is independent of the rate of advance of the freezing front (Beskow 1947). The rate of heave is equal to the rate at which the water arrives at the ice lens. According to Chalmers and Jackson (1970), this rate can be given by:

$$R = \frac{k\rho_w}{\rho_i}\frac{P_{max} - P_L}{h_o - h}$$

where

R = rate of frost heaving,

k = coefficient of permeability of the soil,

ρ_w = density of water,

ρ_i = density of ice,

P_{max} = maximum suction pressure,

P_L = load pressure,

h_o = distance from the surface to the water table, and

h = distance from the surface to the ice lens.

Further, Chalmers and Jackson (1970) suggested that the following equation can be used to determine the rate of advance of the freezing front:

$$V = \left[H_f - H_u - \rho_w Lk\frac{P_{max} - P_L}{h_o - h} \right] \frac{1}{n\rho_i L}$$

where

H_f = (thermal conductivity of frozen soil)(temperature gradient below freezing front),

H_u = (thermal conductivity of unfrozen soil) (temperature gradient above freezing front),

n = volume fraction of the soil that is water, and

L = latent heat per unit volume.

Heaving is related to the rate at which water arrives at the freezing front, which depends on pressure differences that result from supercooling of soil water. The rate of advance of the freezing front thus depends on heat flow conditions.

Permeability

Soil permeability largely determines the rate of water movement in soil, and ultimately whether or not the soil will heave. Permeability is a function of pore size, soil temperature, soil water tension, and type and amount of soil salts. The tension developed at the frostline largely depends on the pore size. Coarse-grained soils are highly permeable, but the flow of water is mainly governed by the tension developed. In fine-grained soils, the tension developed may be large, but the flow is limited by a relatively low permeability. The intermediate permeability and tension conditions in silt soils appear to be conducive to a high rate of frost heaving (Penner 1958).

Soil particle size influences frost heaving, since particle size influences pore size, which in turn affects permeability. According to Casagrande (1931), ice segregation can be expected in nonuniform soils containing more than 3 percent of grains less than 0.02 mm, and in uniform soils containing more than 10 percent less than 0.02 mm. No segregation was observed in soils containing less than 1 percent of grains smaller than 0.02 mm. Beskow (1947) stated that the maximum particle size which will produce measurable heave in 24 hours is 0.1 mm.

Frost heaving is influenced by the nature of the particles. Grim (1952) stated that soils consisting of very fine colloid-sized clay materials show little or no segregation during freezing. Heaving of clay soils, however, depends on the type of clay mineral present and the adsorbed ions.

Clay particles are surrounded by a diffuse double layer of ions within the contiguous water layer. The thickness of the double layer determines to a great extent the heaving characteristics. When two clay particles are less than 15 Å apart, the exchangeable ions are uniformly distributed in the interparticular space and do not separate into two diffuse double layers. Under these conditions there is an attraction between particles, so that they flocculate (Yong and Warkentin 1966). When soil particles flocculate, the result is more open pores for water movement, and segregation of ice into layers is likely. When the interparticular distance exceeds 15 Å, diffuse ion layers form with a resulting net repulsion of soil particles. The repulsion is caused by water being attracted between the particles, thus forcing them apart. In this case, water moves due to a water potential gradient since the concentration of ions is higher in the plane midway between parallel particles than in the outside solution (Yong and Warkentin 1966). When the soil particles become dispersed, heaving is reduced because the pores are smaller and water movement is restricted. Under these conditions, segregation of soil water is reduced.

The thickness of the double layer depends on the valence of the ion and its concentration. The lower the valence and concentration the thicker the diffuse double layer (Yong and Warkentin 1966).

Clays such as montmorillonite have a high surface area and adsorption capacity for certain cations, anions, and organic molecules (Grim 1952). In montmorillonite with sodium as the adsorbed ion, water can enter easily between all of the unit layers and build up to a thickness of at least 100 Å. Thus, even in the presence of large amounts of water, in which the water content would be in excess of the clay mineral content, there would be no fluid water. Such clays are largely impervious, and during freezing there is little or no concentration of ice in layers (Grim 1952).

In montmorillonite with calcium, magnesium, and hydrogen as the exchangeable ions, the situation is different. When the alkaline earths of hydrogen are present as adsorbed ions, water enters between the layers with difficulty and forms thin layers of adsorbed water. In these clays, water present in relatively small amounts beyond about 40 percent of the dry weight of the clay is fluid. In such clays, ice may develop in layers if the water content is fairly high (Grim 1952).

Kaolinite particles are 100 to 1,000 times the size of montmorillonite particles, so their total surface area is relatively small. In addition, kaolinite has no interior surfaces but montmorillonite does. Because of the crystalline structure of kaolinite, only about half the total surface is likely to develop adsorbed water with a definite configuration. Therefore, at relatively low water contents, soils with kaolinite contain some fluid water (Grim 1952) and are susceptible to heaving (fig. 4).

CONTROLLING FROST ACTION

There are several ways in which a soil can be made less susceptible to heaving. The most obvious is to prevent the freezing of the soil pore water. Another method is to reduce the permeability of the soil so that water cannot migrate to the freezing zone at a fast enough rate for ice lenses to form. A third is to cement the soil particles together with a bond strong enough to resist the expansive forces of frost action (Lambe 1956). It is also possible to prevent frost heaving by preventing the supercooling of the soil water. Finally, Cass and Miller (1959) suggested substituting a nonsusceptible soil for a susceptible one. This is not economically feasible as a forest management practice.

There are several ways in which the other methods may be implemented, however.

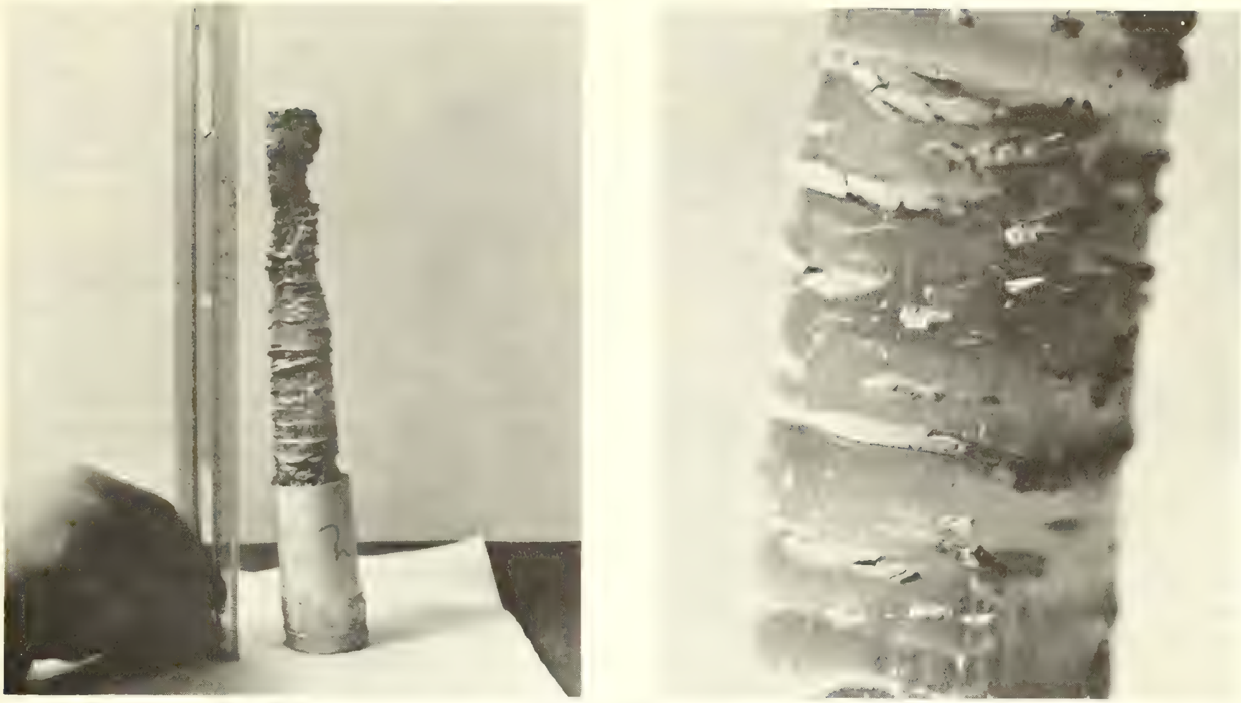

Figure 4.—Example of ice lens formation in pure kaolinite clay. The sample heaved 15 cm (200 percent) in 7 days. The closeup (right) shows little soil in the column, which indicates that the flow of heat to the freezing front was equal to the heat flow to the surface during most of the freezing period.

Dispersing Agents

Dispersing agents for clay soils may be categorized as: (1) those that substitute sodium ions for exchangeable calcium, the latter being removed from the soil solution; and (2) those that, in addition, mask or reverse the positive charges normally found at the edges of the clay plates. Sodium oxalate is an example of the former, and sodium polyphosphates are examples of the latter (Cass and Miller 1959). Clay present in the system tends to become dispersed (because of the increased swelling pressure of the monovalent double layer) and migrates with the moving water to clog the pores, thus reducing the permeability of the soil (Cass and Miller 1959).

Most of the dispersants consist of a polyanionic group (phosphate or sulfonate) and a monovalent cation, usually sodium. Some of the anionic groups can remove any polyvalent cations by forming insoluble products, and others can become attached to the soil mineral surfaces. The sodium ions become adsorbed by the soil, replacing the removed polyvalent and exchangeable cations. The cation exchange (monovalent for polyvalent) and the anion adsorption expand the diffuse double layers around the colloids, thus increasing interparticle repulsion which tends to disperse the soil aggregates. Particles that do not stick together can be packed into a more orderly and denser structure. Attendant with improved structure are higher density, lower permeability, and higher stability to water. By decreasing the size of the soil voids, dispersants also tend to lower the freezing temperature of the soil water (Lambe 1956).

Waterproofing Agents

Soil mineral surfaces can be made hydrophobic with certain additives. One end of the additive molecule becomes adsorbed to a soil particle and the other end of the molecule is hydrophobic. As a result the soil becomes nonwettable. Soil can also be treated with nonhydratable cations that are attracted to the negatively charged soil particles.

Cementing Agents

A frost-susceptible soil may be made nonsusceptible by reducing the proportion of finer particles (clay and silt) by adding cements, or chemicals that cause flocculation. Synthetic polymers become attached to the soil mineral surfaces and link the particles together. Aggregation of soil particles can also be achieved by application of polyvalent cations such as iron (Fe^{+++}) or aluminum (Al^{+++}). The cations act by shrinking the diffuse double layer around the soil colloids enough to permit the particles to cohere.

Another phenomenon, ion fixation, results in aggregation of soil particles. If Fe^{+++} is added to a fine-grained soil, the iron replaces some of the exchangeable cations of the soil. This reaction tends to produce flocculation because interparticle repulsive charges are reduced. If the soil is dried, some of the iron ions link adjacent soil particles with a strong bond that is resistant to water. The iron ions become fixed and are no longer exchangeable (Lambe 1956).

Salts

Salts lower the freezing point of the soil water. In addition, the presence of polyvalent cations in the system contracts the double layer. The salts, with their higher charge, are preferentially attracted to the mineral surface and find their equilibrium positions at short distances from the soil particles, which means that the double layer will be reduced in thickness and osmotic activity and the recharge mechanism will be suppressed (Cass and Miller 1959).

Nucleating Agents

Supercooling of the soil water results in pressure differences and water migration to the freezing front. The addition of nucleating agents to the soil water will result in the water freezing at a higher temperature (there will be less supercooling of the water). If supercooling is prevented, the segregation process can be stopped.

Altering the Radiation Balance of the Soil Surface

If the amount of heat lost from the soil is reduced, the temperature of the soil water may be maintained above the freezing point. The use of mulches, shade, or soil coatings may accomplish this objective.

RESULTS OF VARIOUS CONTROL EXPERIMENTS

Lambe (1956) found that dispersants were effective in reducing frost heaving. Some of the more promising dispersants were: sodium hexametaphosphate, sodium tripolyphosphate, and tetrasodium pyrophosphate. Results using waterproofing agents such as polyethylene glycol were erratic and the costs were high. Cementing agents are expensive because too much material is needed to be effective. Ferric chloride, however, was effective at rates as low as 0.1 percent of the soil weight.

Chemicals that lower the freezing point of the soil water, such as calcium chloride, also appear useful in preventing frost heaving. According to Smith (1952), applying calcium chloride at a rate of 2 percent of the soil weights protects silty soils from frost heaving. In clay soils, an application of 1 percent affords protection, and only 0.1 percent was required for graded mixes. After a period of 5 to 10 years, one-third to one-half of the chemical still remained in the soil.

Vonnegut and Chessin (1971), working with nucleating agents, found that by coprecipitating silver bromide with silver iodide, solutions were formed in which bromide atoms were substituted for as many as 30 mole percent of the iodine atoms in the silver iodide structure. As the fraction of iodine replaced by bromine increased up to about 30 percent, supercooling was reduced by a factor of almost two.

Soil cover modifies soil temperature and subsequent heaving. Kohnke and Werkhoven (1963) found that 1.5 tons of wheat straw per acre resulted in 6.5 freezing-thawing cycles at the 1-inch soil depth in a silt loam soil, compared to 22 cycles in bare plots over a winter season.

Decker and Ronningen (1957) found that heaving of wooden dowels was related to degree of cover and species of vegetation present. Dowels heaved most in ladino clover (*Trifolium repens*) plots. No differences in heaving were attributed to variations in dowel diameter.

Gradwell (1960) noted that needle ice did not form under tussocks (grass clumps) in New Zealand. Krumbach and White (1964) observed that frost penetrated 12 inches in plots bare of vegetation in Michigan, compared to 3 inches in plots with a cover of alfalfa (*Medicago sativa*).

According to Thorud and Anderson (1969), white pine (*Pinus strobus*) litter samples had better insulating qualities than either red pine (*P. resinosa*) or oak (*Quercus* sp.) litter samples. Graber (1971) reported that the shading of white pine seedlings during the dormant and growing season reduced heaving losses.

SUMMARY

1. Frost heaving of tree seedlings is a serious problem in areas which have below-freezing temperatures, adequate soil moisture, and susceptible soils.
2. Heaving of first-year seedlings is more severe than heaving of transplants.
3. Frost heaving is caused by a segregation of the soil water, which freezes into lenses of ice. The water segregates because of a lowering of the freezing point or supercooling of the soil water. Supercooling is the result of several factors, including adsorption and negative pressure. The difference in freezing points between free water and soil water at the ice line provides the free energy necessary to draw water to the line and lift the soil. The flow of water to the

freezing front is governed by the permeability of the soil and the negative pressure or tension developed.

4. Frost heaving may be controlled by lowering the freezing point of the soil water, restricting the flow of water through the soils, cementation of the soil particles, and by preventing supercooling of the soil water.

LITERATURE CITED

Aldrich, Harl P.
1956. Frost penetration below highway and airfield pavements. Highw. Res. Board, Bull. 135, p. 45-62.

Beskow, Gunnar.
1947. Soil freezing and frost heaving with special application to roads and railroads. Swedish Geol. Soc. Ser. C, No. 375, 26th Yearb. No. 3, 1935. [With a special supplement for the English translation of progress from 1935 to 1946.] Northwest Univ. Technol. Inst., Evanston, Ill.

Biswell, H. H., A. M. Schultz, D. W. Hedrick, and J. I. Mallory.
1953. Frost heaving of grass and brush seedlings on burned chamise brushlands in California. J. Range Manage. 6(3):172-180.

Casagrande, A.
1931. Discussion of frost heaving. Highw. Res. Board Proc. 11, Part 1, p. 168-172.

Cass, L. A., and R. D. Miller.
1959. Role of the electric double layer in the mechanism of frost heaving. U.S. Army, Corps Eng., Snow, Ice, and Permafrost Res. Establ., Res. Rep. 49, 15 p. Wilmette, Ill.

Chalmers, Bruce.
1959. How water freezes. Sci. Am. 200(2):114-122.

Chalmers, Bruce, and Kenneth A. Jackson.
1970. Experimental and theoretical studies of the mechanism of frost heaving. U.S. Army, Corps Eng., Cold Reg. Res. Eng. Lab., Res. Rep. 199, 23 p. Hanover, N.H.

Corte, A. E.
1961. The frost behavior of soils: Laboratory and field data for a new concept. Part 1: Vertical sorting. U.S. Army, Corps Eng., Cold Reg. Res. Eng. Lab., Res. Rep. 85, 22 p. Hanover, N.H.

Decker, A. M., Jr., and T. S. Ronningen.
1957. Heaving in forage stands and in bare ground. Agron. J. 49:412-415.

Edlefsen, N. E., and A. B. C. Anderson.
1943. Thermodynamics of soil moisture. Hilgardia 15(2):31-298.

Fahey, B. D.
1973. An analysis of diurnal freeze-thaw and frost heave cycles in the Indian Peaks region of the Colorado Front Range. Arctic and Alpine Res., 5(3, Part 1):269-281.

Graber, R. E.
1971. Frost heaving . . . seedling losses can be reduced. Tree Planters' Notes 22(4):24-28.

Gradwell, M. W.
1960. Soil frost action in snow-tussock grassland. N.Z. J. Sci. 3(4):580-590.

Grim, R. E.
1952. Relation of frost action to the clay-mineral composition of soil materials. Highw. Res. Board, Spec. Rep. 2, p. 167-172.

Haasis, F. W.
1923. Frost heaving of western yellow pine seedlings. Ecology 4:378-390.

Higashi, Akira.
1958. Experimental study of frost heaving. U.S. Army, Corps Eng., Snow, Ice, and Permafrost Res. Establ., Res. Rep. 45, 20 p. Wilmette, Ill.

Heidmann, L. J.
1974. An investigation into the causes and prevention of frost heaving of forest tree seedlings. Ph.D. Diss., Univ. of Ariz., 183 p. Tucson.

Kaplar, Chester W.
1971. Experiments to simplify frost susceptibility testing of soil. U.S. Army, Corps Eng., Cold Reg. Res. Eng. Lab., 21 p. Hanover, N.H.

Kersten, M. S.
1952. Thermal properties of soils. Highw. Res. Board Spec. Rep. 2, Frost action in soils: A symposium. NAS-NRC, Publ. 213, p. 161-172.

Kohnke H., and C. H. Werkhoven.
1963. Soil temperature and soil freezing as affected by an organic mulch. Soil Sci. Soc. Am. Proc. 27:13-17.

Krumbach, A. W., Jr., and D. P. White.
1964. Moisture, pore space, and bulk density changes in frozen soil. Soil Sci. Soc. Am. Proc. 28(3):422-425.

Lambe, William.
1956. Modification of frost heaving of soils with additives. Highw. Res. Board, Bull. 135, p. 1-23.

Larson, M. M.
1960. Frost heaving influences drought hardiness of ponderosa pine seedlings. U.S. Dep. Agric., For. Serv., Rocky Mt. For. and Range Exp. Stn., Res. Note 45, 2 p, Fort Collins, Colo.

Larson, M. M.
1961. Seed size, germination dates, and survival relationships of ponderosa pine in the Southwest. U.S. Dep. Agric., For. Serv., Rocky Mt. For. and Range Exp. Stn., Res. Note 66, 4 p, Fort Collins, Colo.

Low, P. F., and C. W. Lovell.
1959. The factor of moisture in frost action. Highw. Res. Board, Bull. 225, p. 23-33.

Martin, R. T.
1959. Rhythmic ice banding in soil. Highw. Res. Board, Bull. 218:11-23.

Outcalt, S. I.
1969. Weather and diurnal frozen soil structure at Charlottesville, Virginia. Water Resour. Res. 5(5):1377-1382.

Penner, E.
1958. The nature of frost action. Proc. Thirty-eighth Convention of the Canadian Good Roads Assoc., Tech. Pap. 53, p. 234-243.

Penner, E.
1959. The mechanism of frost heaving in soils. Highw. Res. Board, Bull. 225, p. 1-22.

Portz, H. L. 1967. Frost heaving of soil and plants. 1. Incidence of frost heaving of forage plants and meteorological relationships. Agron. J. 59:341-344.

Schramm, J. R.
1958. The mechanism of frost heaving of tree seedlings. Am. Philos. Soc. Proc. 102(4):333-350.

Smith, H. R.
1952. Remedies and treatments. Calcium chloride treatment of frost action. Highw. Res. Board, Spec. Rep. 2, Frost action in soils: A symposium. NAS-NRC, Publ. 213, p. 326-330.

Soons, J. M., and D. E. Greenland.
1970. Observations on the growth of needle ice. Water Resour. Res. 6(2):579-593.

Taber, S.
1929. Frost heaving. J. Geol. 37:428-461.

Taber, S.
1930. The mechanics of frost heaving. J. Geol. 38:303-317.

Thorud, D. B., and D. A. Anderson.
1969. Freezing in forest soil as influenced by soil properties, litter, and snow. Water Resour. Res. Center, Univ. Minn. Grad. Sch., Bull. 10, 41 p.

Vershinin, P. V., B. V. Deriagin, and N. V. Kirilenko.
1960. The nonfreezing water in soil. [O. Nezamerzaiushchei Vode V. Pochve] ACFEL Transl. 30, 10 p. U.S. Army, Eng. Div., Waltham, Mass.

Vonnegut, B., and H. Chessin.
1971. Ice nucleation by coprecipitated silver iodide and silver bromide. Science 174(4012):945-946.

Yong, R. N., and B. P. Warkentin.
1966. Introduction to soil behavior. 451 p. Macmillan Co., N.Y.

Agriculture—CSU, Ft. Collins

Heidmann, L. J.
1976. Frost heaving of tree seedlings: A literature review of causes and possible control. USDA For. Serv. Gen. Tech. Rep. RM-21, 10 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Describes phenomenon of frost heaving of tree seedlings and objects from the soil. Frost heaving is primarily a soil surface event resulting from a segregation of soil water which freezes into ice lenses. Suggested methods of control involve lowering the freezing point of the soil water or restricting water flow through the soil to the freezing front.

Keywords: Frost heaving, soil water segregation, supercooling, tree seedling mortality.

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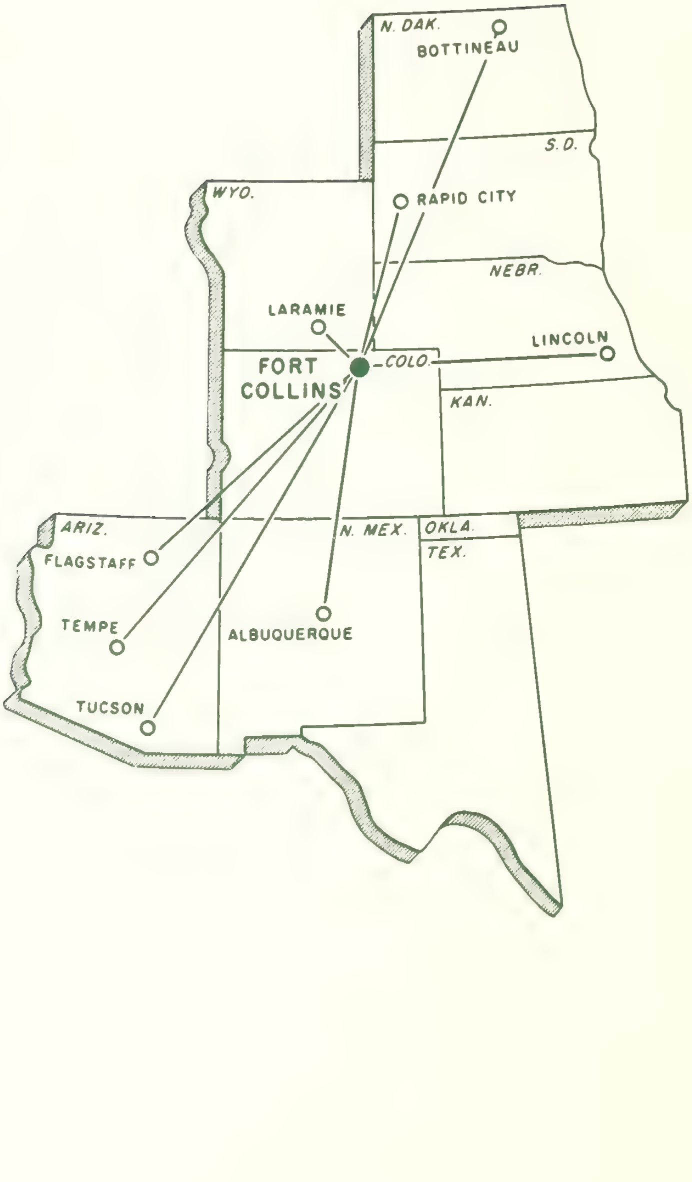
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FIFTY-YEAR RECORD OF VIRGIN STAND DEVELOPMENT IN SOUTHWESTERN PONDEROSA PINE

rles C. Avery
deric R. Larson
ert H. Schubert

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USDA Forest Service
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Abstract

Avery, Charles C., Frederic R. Larson, and Gilbert H. Schubert.
1976. Fifty-year records of virgin stand development in southwestern ponderosa pine. USDA For. Serv. Gen. Tech. Rep. RM-22, 71 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521

Ten periodic inventories of an unburned virgin tract of southwestern ponderosa pine near Flagstaff, Arizona, have yielded growth and mortality data on more than 3,000 trees. Fifty years of change on this 40-acre tract are documented, principally in nonmetric units, by (1) individual tree records, (2) 2.5-acre (1.01-ha) subplot summaries of basal area and tree census (tree count) data, and (3) composite stand tables which display volumes (cubic feet and board feet), census data, mortality data and causes, net periodic basal area, volume, and diameter growth. This information should be useful in modeling stand development and also as a data source for research and teaching.

Keywords: *Pinus ponderosa*, stand structure, natural areas.

USDA Forest Service
General Technical Report RM-22

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Fifty-Year Records of Virgin Stand Development in Southwestern Ponderosa Pine[1]

Charles C. Avery, Frederic R. Larson, and Gilbert H. Schubert[2]

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[1] *Contribution No. 101 to the Coniferous Forest Biome, U.S. International Biological Program.*

[2] *Avery is an Associate Professor, School of Forestry, Northern Arizona University. Larson is a Silviculturist and Schubert is a Principal Silviculturist assigned to the Rocky Mountain Forest and Range Experiment Station located at Flagstaff, in cooperation with Northern Arizona University. Station's central headquarters is maintained at Fort Collins, in cooperation with Colorado State University.*

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Fifty-Year Records of Virgin Stand Development in Southwestern Ponderosa Pine

Charles C. Avery, Frederic R. Larson, and Gilbert H. Schubert

Introduction

In 1908, the USDA Forest Service began its first research activities in the Southwest by assigning G. A. Pearson to study the silviculture of ponderosa pine *(Pinus ponderosa)* and to devise appropriate management guidelines for this forest type. After the establishment of the Fort Valley Experimental Forest in northern Arizona, Pearson soon selected a 240-acre (97.12-ha) uncut and unburned tract of mature pine to serve as the principal control unit, or standard of comparison, for his experiments. These virgin stands have remained in relatively good vigor—they are largely uninfected by dwarf mistletoe or other pathogens—and are the source of the data presented here (fig. 1). There is no record of any forest fire in the immediate vicinity of the tract.

Figure 1.—Mature stand of ponderosa pine on the Fort Valley Experimental Forest as it appeared in June of 1937.

Because sampling theory was not well developed by 1920, all trees greater than 3.6 inches (9.14 cm) diameter breast height (d.b.h.) were tagged and measured in the initial inventory of 154 acres (62.32 ha) of this virgin tract. Later, a 76-acre portion of this tract was designated a part of the G. A. Pearson Natural Area, and it is from this unit that records of 10 subplots (with a total area of 39.55 acres) have been chosen for final tabulation. These 10 inventories of a virgin tract of ponderosa pine, documenting its development over 50 years, provide a wealth of information concerning the performance of an unmanaged ponderosa pine forest.

These long-term data quantitatively describing the G. A. Pearson Natural Area can, hopefully, serve as a standard of comparison for other managed, utilized, and artificial ecosystems (Ohmann 1973). Furthermore, this 50-year record provides a valid basis for describing the natural stand development of an important North American forest type. The scarcity of this kind of information in American forestry literature, and its necessity for the validation of both ecological and management models, should also make these data useful to a wide variety of investigators.

Since these records have not been statistically analyzed, their significance is not interpreted here.

Description of the Site

The G. A. Pearson Natural Area is located 9 miles (14.5 km) northwest of Flagstaff, Arizona, along U.S. Highway 180 (longitude 111°45' west, latitude 35°16' north). The elevation is 7,400 feet (2,255 m) and the topography is level to very gently rolling. A short distance to the east, the foothills of the San Francisco Peaks break this relief dramatically.

The local climate is strongly influenced by topography. Moreover, scattered thundershower activity in the summer makes point precipitation highly variable, and annual fluctuations of all factors make between-year comparisons difficult. Generally, the cold temperate Mediterranean climate is modified toward a dry regime, with a late spring (May, June) drought being normal. Over the 60-year period from 1909 to 1968, the weather station at Fort Valley indicated the average annual precipitation to be 22.6 inches (574 mm), the highest summer temperature to be 97°F (36.1°C) and the lowest winter temperature to be -37°F (-38.3°C) (Schubert 1974). The average growing season is only 94 days.

Late Tertiary lava flows are responsible for the characteristics of the soils on the research area. These Brolliar series soils consist of montmorillonite clay-loams which have a high moisture-holding capacity, insuring a source of moisture available to ponderosa pine even during extensive droughts. Although there are some small rock outcrops on the study area, generally the tract has the potential of being fully occupied by trees.

The Natural Area is representative of the southwestern ponderosa pine type. The type exists mainly as a climax forest in pure irregular uneven-aged stands consisting of small even-aged groups varying in size from a few trees to several acres (Schubert 1973). The forest has an abundance of large overmature yellow pines and small blackjacks with a deficiency of trees in the intermediate size classes. ("Blackjack" is the local name given to a relatively young ponderosa pine—generally no older than 150 years—which has dark bark with narrow, rough ridges. It is distinctly different in appearance from a "yellow pine" which has a reddish-brown to yellow bark with wide, smooth plates.) Dense stands of young blackjacks, which were established in 1919, are just now beginning to enter the minimum size class (fig. 2).

Ponderosa pine, a light-demanding species, does not regenerate under low light intensity and cannot tolerate heavy root competition. Where stands are dense, with a basal area stocking greater than 180 ft^2 per acre (41 m^2 per ha), lower vegetation is usually absent (Schubert 1974). Arizona fescue *(Festuca arizonica)* and mountain muhly *(Muhlenbergia montana)* are the major understory species in openings and in stands of low stocking.

The site index of the area is 80 to 85 (height in feet at 100 years of age) (Minor 1964).

Field Inventory Methods

From its beginning, the silvicultural research at Fort Valley had a strong management orientation. Various systems for describing "vigor" were devised, and when inventoried each tree's "condition" was tallied along with its diameter (d.b.h.). Inventories were made every 5 years from 1920 through 1960. The last inventory was made in 1970. At the time of initial inventory in 1920,

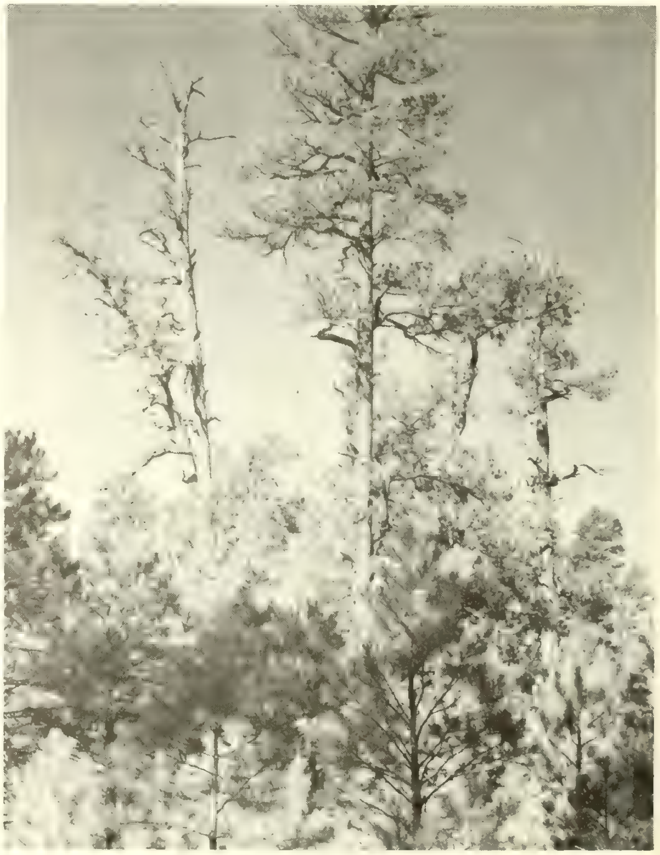

Figure 2.—While some overmature trees in this virgin ponderosa pine stand are dead or dying, their place is being filled by young saplings and poles.

every stem larger than the minimum acceptable size (3.6 inches (9.14 cm) d.b.h.) was therefore not only numbered, tagged, and measured, but its condition was also described. In the 1940-60 inventories the minimum size was raised to 7.6 inches (19.30 cm) d.b.h.

Calipers were utilized in early inventory work. The records are not clear as to when the use of the diameter tape became accepted, although it was used prior to the 1960 inventory. The original tree numbers were supplemented by a new numbering scheme in 1950 when a grid of 2.5-acre (1.01-ha) plots was imposed on the tract, but because the original tags remain on each tree a cross correlation has been simple.

The principal requirements demanded by this inventory system were trained and careful observers and adequate funding: the data reveal clearly that some inventory crews were much more attentive to detail in rating tree condition than others.

Automatic Data Processing

Section 1: Individual Tree Data

The original field sheets and tabulations resulting from all inventories were compiled, and this information is presented as the **individual tree data section** of this report. The printed format is an image of the card file.

1. **Age class** indicates whether a tree was judged to be a "blackjack" (code 1) or "yellow pine" (code 2). Only age class data from the 1920, 1940, and 1960 inventories are presented.

2. **Age-vigor** denotes an attempt to classify the growing stock according to its growth potential. In this publication, "age-vigor" is shown for three 15-year periods:

   Period I: 1925-1940
   Period II: 1940-1955
   Period III: 1955-1970

   Age Code (first of two digits):
   1 "young blackjacks", d.b.h. $<$ 12 inches.
   2 "sawtimber-size blackjacks", d.b.h. $>$ 12 inches.
   3 intermediates or young yellow pines (mature).
   4 old yellow pines (overmature).
   Vigor Code (second of two digits):
   0 15-year periodic diameter growth $\geq$ 2.10 inches.
   1 15-year periodic diameter growth between 1.50 and 2.09 inches.
   2 15-year periodic diameter growth between 0.80 and 1.49 inches.
   3 15-year periodic diameter growth between 0.40 and 0.79 inch.
   4 15-year periodic diameter growth $<$ 0.39 inch.
   "X" Denotes incomplete measurements for the period. Various "Age-Vigor" classes were in vogue during the 40-year period represented by these inventories. Many were a modified Keen class rating (Keen 1943) or a modified Thomson approach (Thomson 1940), both of which utilized crown class schemes. Because it was necessary to obtain uniformity for this publication, a more rigorous approach has been chosen. Note also that the "age" is not strictly defined but is rather subjective except where diameter limits prevail.

3. **Tree condition** refers to whatever faults the observer noted for a particular tree. These observations were subjective, so each subsequent observer might report different defects. The codes for each inventory have been correlated and are listed in the appendix.

4. **D.b.h.** measurements have been made consistently at the same height, which is a permanently marked location on the bole. To complete the sequence of measurements, missing data were calculated by linear extrapolation of the subsequent annual diameter increment. The lower diameter limit is 3.6 inches (9.14 cm).

Section 2: Subplot Data

Individual tree data provide the basis for all compilation in this section as well as section 3. The subplots are nominally 2.5 acres each, and both census (stem count) and basal area data are displayed on a per-acre basis. Diameter class limits are set above the median (i.e., 3.6 to 4.5 inches d.b.h. for the 4-inch diameter class). Basal area subtotals are calculated as sums of the individual trees and not on the basis of class averages.

Section 3: Composite Stand and Stock Tables

Composite tables listing the number of trees and basal area, as well as cubic-foot and board-foot volumes on a per-acre basis, are presented for each year of inventory for the entire tract. These volumes were obtained after constructing a local height-diameter curve, where:

$$Ht = -4.659 + 5.363\ \text{d.b.h.} - 0.062\ \text{d.b.h.}^2$$

$$Ht\ (\text{feet}),\ \text{d.b.h.}\ (\text{inches}){:}\ r^2 = 0.89,\ n=75.$$

The actual inventory diameter data and the derived heights provided the independent variables for use in a volume regression equation which has been developed for southwestern ponderosa pine (Myers 1972). To allow for unutilizable wood due to crook and sweep, and reduced volume due to fork and broken top, the derived volumes were arbitrarily reduced by 10 percent.

Computations were done on an individual tree basis, and the results were summed to obtain the diameter class values which are presented in the stand tables by inventory year. Similar tables for mortality and growth are given for the nine periods between inventories.

There are six summary tables, in two groups of three each. In the first group (p. 69), a table of net average annual diameter growth by size classes and growth periods and a table showing the percent of trees in a diameter class moving up into the next class during the growth period enable one to analyze fluctuations in growth rates. The final table in this first group defines the percent mortality by killing agent on a diameter-class basis for all growth periods. The last row of this table gives a weighted average of mortality by killing agent.

The last group of three tables (p. 71) presents grand totals; they summarize stand, mortality, and net-growth data.

Literature Cited

Keen, F. P.
1943. Ponderosa pine tree classes redefined. J. For. 41:249-253.

Ohmann, L. F.
1973. Vegetation data collection in temperate forest research natural areas. USDA For. Serv. Res. Pap. NC-92, 35 p. North Cent. For. Exp. Stn., St. Paul, Minn.

Minor, Charles O.
1964. Site index curves for young-growth ponderosa pine in northern Arizona. U.S. For. Serv. Res. Note RM-37, 8 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Myers, Clifford A.
1972. Volume, taper, and related tables for southwestern ponderosa pine. U.S. For. Serv. Res. Pap. RM-2, 24 p. (Rev.) Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Schubert, Gilbert H.
1973. Southwestern ponderosa pine. p. 45-46. *In* Silvicultural systems for the major forest types of the United States. U.S. Dep. Agric., Agric. Handb. 445, 124 p.

Schubert, Gilbert H.
1974. Silviculture of southwestern ponderosa pine: The status of our knowledge. USDA For. Serv. Res. Pap. RM-123, 71 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Thomson, Walter G.
1940. A growth rate classification of southwestern ponderosa pine. J. For. 38:547-553.

Appendix

Code	Explanation
00	No apparent defect or fault
01	Unmerchantable—fork or crotch
02	Fork or crotch below 18 feet
03	Fork or crotch above 18 feet
04	Suppressed
05	Pruned
09	Merchantable—spike top
10	Unmerchantable—spike top or complete girdle below 18 feet
11	Unmerchantable—crook or sweep
12	Unmerchantable—limby
13	Leans more than 4° from vertical
14	Merchantable—crook or sweep
20	Mistletoe—light in crown
21	Mistletoe—heavy in crown
22	Mistletoe—light on bole
23	Mistletoe—heavy on bole
24	Mistletoe—on bole and crown
25	Mistletoe—top dead
30	Squirrel—light damage
31	Squirrel—medium damage
32	Squirrel—heavy damage
33	Porcupine—partial girdle in crown
34	Porcupine—partial girdle below crown
35	Porcupine—complete girdle
40	Rust—new in crown
41	Rust—advanced in crown
42	Rust—new in bole
43	Rust—advanced in bole
44	*Elytroderma* (needle blight) in crown
45	Red rot
46	Other heart rot
50	Tipmoth—light
51	Tipmoth—heavy
52	*Dendroctonus* present
53	*Ips* present
54	Turpentine beetles present
55	Shoot moth present
60	Lightning—top dead
61	Lightning—bole split
62	Lightning—scar on one-quarter bole
63	Lightning—scar on over one-quarter bole
64	Fire scar on one-quarter bole at base
65	Fire scar on over one-quarter bole at base
66	Fire—bark burnt on one-half bole at base
67	Fire—bark burnt completely at base
70	Snow bend—less than 30° from vertical
71	Snow bend—from 30° to 45° from vertical
72	Snow bend—more than 45° from vertical
73	Snow—top broken
74	Wind—top broken
76	Lightning—top broken
90	Killing agent—lightning
91	Killing agent—wind
92	Killing agent—insects
93	Killing agent—rust
94	Killing agent—dwarf mistletoe
95	Killing agent—suppressed
96	Killing agent—root rot
98	Killing agent—other identifiable agents (squirrel, snow bend)
99	Killing agent—unidentified agent

Section 1: INDIVIDUAL TREE DATA

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	1	1	1	1	1	10	10	11	0	0	2	0	0	0	0	0	0	0	10.3	11.4	12.5	13.6	14.5	15.4	15.9	16.6	17.0	18.4
61	1	2	1	1	1	20	21	22	0	0	0	0	0	0	0	0	0	0	18.9	19.9	21.1	22.3	23.1	23.8	24.2	24.7	25.0	25.7
61	1	3	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.2	5.7	6.2
61	1	4	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.3	5.3	5.8	6.3
61	1	5	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	5.2	6.0	6.8	7.4	7.9	8.4	9.5
61	1	6	2	2	2	24	24	34	0	0	0	0	0	60	0	0	0	60	24.5	24.[illegible]	24.6	24.6	24.6	24.7	24.8	24.8	25.1	25.2
61	1	7	2	2	2	22	22	33	0	0	2	0	0	0	30	0	0	0	24.6	24.9	25.2	25.8	26.2	26.8	26.9	27.2	27.3	27.7
61	1	8	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.5	5.0	6.0
61	1	9	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.2	4.7	5.2	5.7	6.2	7.2
61	1	10	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	4.7	5.2	6.2
61	1	11	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	4.9	5.4	5.9	6.9
61	1	12	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.3	4.8	5.3	5.8	6.8
61	1	13	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	4.6	5.1	5.6	6.1	7.1
61	1	14	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.3	4.8	5.3	5.8	6.3
61	1	15	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.9	4.4	4.5	5.4	5.9	6.4	6.9	7.9
61	1	16	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	4.6	5.1	6.1
61	1	17	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.6	4.4	4.9	5.4	6.4
61	1	18	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	4.6	5.1	6.1
61	1	19	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.3	4.8	5.3	5.8	6.3	7.3
61	1	20	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	4.7	5.2	6.2
61	1	21	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	4.7	5.2	6.2
61	1	22	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.5	5.0	5.5	6.5
61	1	23	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	4.6	5.1	5.6	6.1	7.1
61	1	24	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.3	4.8	5.3	5.8	6.8
61	1	25	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	3.5	4.9	6.1	7.4	8.1	8.9	10.0
61	1	26	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	2	.0	.0	.0	3.8	4.7	5.7	6.9	7.6	8.4	9.7
61	1	27	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	4.1	5.1	6.1	7.6	8.4	9.1	10.5
61	1	28	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	4.9	6.1	6.6	7.3	8.3
61	1	29	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	4.2	4.9	5.4	6.0	7.0
61	1	30	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.2	6.5
61	1	31	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	.0	4.6	6.1
61	1	32	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.1	6.8
61	1	33	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.9	6.4
61	1	34	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.5	6.0	6.9	7.7	9.2
61	1	35	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.5
61	1	36	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.1	6.0	6.9	8.4
61	1	37	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.9	5.8	6.7	8.2
61	1	38	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.5	6.3	7.4	8.8	9.4
61	1	39	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.6	6.1
61	1	40	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.8	5.5	6.4	7.9
61	1	41	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.7	6.2
61	1	42	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	3	3	.0	.0	.0	.0	.0	.0	3.6	4.5	5.2	6.7
61	1	43	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	3	3	.0	.0	.0	.0	.0	.0	.0	4.1	4.8	6.3
61	1	44	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.3	5.1	5.8	7.3
61	1	45	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.7	6.2
61	1	46	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	3	3	.0	.0	.0	.0	4.2	5.2	6.2	7.4	8.8	10.0
61	1	47	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.0	6.6
61	1	48	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.9	6.4
61	1	49	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.9	4.6	6.2	7.4	9.0	10.8
61	1	50	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	5.2	6.0	6.9	8.4
61	1	51	1	1	1	1X	10	10	0	0	0	0	0	0	0	3	3	3	.0	.0	.0	.0	4.1	4.9	6.0	6.9	7.7	9.2
61	1	52	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.1
61	1	53	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.8	6.3
61	1	54	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.9	6.4
61	1	55	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.4	5.1	6.8
61	1	56	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.7	5.4	6.2	7.7
61	1	57	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.8	6.2
61	1	58	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	83	.0	.0	.0	.0	.0	4.5	6.0	7.0	7.8	9.4
61	1	59	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.5	6.0	7.0	7.8	9.4
61	1	60	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.9	5.6	7.4	8.6	10.0
61	1	61	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	4.3	6.1	7.4	8.1	10.2
61	1	62	1	1	1	1X	1X	11	0	0	0	0	0	0	2	2	2	2	.0	.0	.0	.0	.0	.0	4.1	4.6	5.2	6.2
61	1	63	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.7	5.5	6.5
61	1	64	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.1	5.9	6.9
61	1	65	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.0	5.6	6.6
61	1	66	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.4	5.4	6.0	7.0
61	1	67	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	5.9	6.8	7.4	8.8
61	1	68	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	4.0	4.9	5.5	6.5
61	1	69	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.1	5.8	6.8
61	1	70	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.8	6.0	6.8	7.8
61	1	71	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.8	5.7	6.4	7.4
61	1	72	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	5.1	6.1
61	1	73	0	1	1	44	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	5.4	6.5	7.4	8.3	9.3
61	1	74	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.0	6.0
61	1	75	1	1	1	20	22	22	0	0	2	0	0	0	0	0	0	0	26.8	27.[illegible]	28.8	30.0	30.8	31.2	31.6	31.9	32.4	33.3
61	1	76	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.0	5.8	6.6	7.6
61	1	77	1	1	1	10	10	12	0	0	0	0	0	0	0	0	0	0	.0	4.8	5.1	6.8	8.1	9.2	9.9	10.6	11.1	11.9
61	1	78	0	1	1	44	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	5.1	6.3	7.4	8.0	8.9
61	1	79	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.1	5.8	7.1	8.4	9.3	10.2	10.9	11.9
61	1	80	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.9	5.5	6.3	7.3
61	1	81	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.8	5.6	6.6
61	1	82	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.2	6.2
61	1	83	0	1	1	44	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.3	5.6	6.[illegible]	7.3	8.3	9.6
61	1	84	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.0	5.8	6.8
61	1	85	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.6	5.4	6.4
61	1	86	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.7	4.0	5.8	6.7	7.7	8.2	9.0
61	1	87	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.1	4.2	5.5	6.3	7.4	7.7	8.2
61	1	88	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.1	6.0	7.1	8.1	8.6	9.4	9.8	10.8
61	1	89	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	5.1	6.0	6.8	7.8
61	1	90	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.8	5.4	6.4

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61   1   91   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.1   5.1   6.1
61   1   92   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.1   5.4   6.4   7.4
61   1   93   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.5   5.7   6.7
61   1   94   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0 33 33      .0    .0    .0    .0    .0    .0   4.2   5.9   6.9   7.9
61   1   95   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   5.2   6.2
61   1   96   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   5.2   6.2
61   1   97   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.1   5.3   6.3
61   1   98   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   5.6   6.6   7.6
61   1   99   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.9   5.9
61   1  100   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.5   5.6   6.6

61   1  101   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.2   5.4   6.4
61   1  102   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.8   4.7   6.5   7.3   8.3
61   1  103   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   5.1   6.1   7.1
61   1  104   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.4   6.1   7.1   8.1
61   1  105   2  2  2   43 44 44    9  9  9  9  9  9  9  9  9 52    15.1  15.2  15.3  15.5  15.7  15.9  15.9  16.0  16.1  16.2
61   1  106   2  2  2   32 33 32    0  0  0  0  0  0  0  0  0 14    20.9  21.0  21.1  21.4  22.0  22.4  22.5  22.7  22.9  23.6
61   1  107   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.7   5.2   6.2
61   1  108   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.9   5.8   6.8
61   1  109   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.3   6.3
61   1  110   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   5.4   6.4   7.4

61   1  111   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   5.0   6.5   7.5
61   1  112   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   5.3   6.5   7.5
61   1  113   1  1  1   10 10 22   13 45 45  0  0  0  0  0  0  0     6.7   7.8   9.5  10.8  11.8  12.6  13.4  14.0  14.5  15.4
61   1  114   1  1  1   1X 10 12    0  0  0  0  0  0  0  0  0 14      .0    .0    .0    .0   4.0   5.9   7.0   8.1   8.6   9.5
61   1  115   1  1  1   10 11 12    0 33  0  0  0  0  0  0  0  0     4.1   5.1   6.3   7.3   8.2   8.8   9.2   9.7  10.1  10.9
61   1  116   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   3.6   4.7   6.1   7.4   8.1   9.3
61   1  117   1  1  1   1X 1X 12    0  0  0  0  0 33 33 33  0 33      .0    .0    .0    .0    .0   4.4   4.9   5.7   6.2   6.8
61   1  118   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 33      .0    .0    .0    .0    .0   4.1   4.9   5.5   6.5   8.0
61   1  119   1  1  1   10 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0   5.7   7.2   8.5   9.5  10.2  10.9  11.5  12.6
61   1  120   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.8   4.6   5.2   5.8   7.0

61   1  121   1  1  1   1X 1X 12    0  0  0  0  0  0  0  0  0 14      .0    .0    .0    .0    .0   4.0   5.0   6.0   6.4   7.4
61   1  122   1  1  1   1X 11 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0   4.0   5.1   6.0   6.6   7.1   7.7   8.8
61   1  123   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.3   4.8   5.3   6.3
61   1  124   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.1   4.6   5.1   6.1
61   1  125   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.3   4.8   5.3   6.3
61   1  126   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.4   6.2   6.8   7.3   8.3
61   1  127   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.6   4.6   5.8   6.3   7.3
61   1  128   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.9   5.8   6.8
61   1  129   1  1  1   2X 10 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0   4.0   5.3   6.8   7.7   8.9   9.8  11.9
61   1  130   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.3   4.9   5.6   6.6

61   1  131   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.5   5.0   6.0
61   1  132   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.2   4.9   5.5   6.5
61   1  133   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.6   5.3   6.3
61   1  134   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.3   5.1   5.7   6.7
61   1  135   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  9  9      .0    .0    .0    .0    .0    .0   4.1   4.8   5.5   6.5
61   1  136   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.0   5.3   6.0   7.0   8.0
61   1  137   1  1  1   1X 11 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0   3.9   5.1   5.9   6.3   6.7   7.3   8.3
61   1  138   1  1  1   1X 1X 12    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.0   4.9   6.1   6.1   7.1
61   1  139   1  1  1   10 11 21    0 34  0  0  0  0  2  0  0  0     4.0   5.7   7.5   8.6   9.9  10.7  11.1  11.7  12.2  13.4
61   1  140   1  1  1   1X 12 13    0  0  0  0  0  0  0  0  0 14      .0    .0   3.8   4.5   5.1   5.6   5.6   6.0   6.3   6.7

61   1  141   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.3   5.0   6.1   7.1
61   1  142   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  2      .0   3.7   4.8   6.3   7.3   8.1   8.6   9.0   9.1  10.1
61   1  143   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.4   4.9   5.4   6.4
61   1  144   1  1  1   1X 1X 12    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.7   5.1   6.1
61   1  145   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.1   4.9   5.1   6.2   7.2
61   1  146   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.0   5.8   6.3   7.0   8.0
61   1  147   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.3   4.9   5.9   6.9
61   1  148   1  1  1   1X 11 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0   3.9   5.4   6.3   6.8   7.4   8.9  10.0
61   1  149   1  1  1   1X 10 12    0  0  0  0  0  0  0  0  0  0      .0    .0   4.0   5.0   6.3   7.4   8.0   8.8   9.3  10.2
61   1  150   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.2   4.7   5.3   6.0   7.0

61   1  151   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.2   5.0   5.8   7.1
61   1  152   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   4.3   5.6   6.8   7.9   8.5   9.5
61   1  153   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.3   5.1   6.0   7.6
61   1  154   1  1  1   1X 10 11    0  0  0  0  0 14 14 14 14 14      .0    .0   4.3   6.0   7.2   8.2   8.7   9.5  10.0  11.1
61   1  155   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0   3.6   5.3   6.4   7.1   7.9   8.5   9.4
61   1  156   1  1  1   10 10 21    0  0  0  0  0 14 14 14  3  3      .0   3.8   5.9   7.6   8.9   9.9  10.6  11.4  12.0  13.1
61   1  157   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.5   5.3   6.8
61   1  158   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0   4.5   4.9   5.5   6.3   7.8   8.4   9.4
61   1  159   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 33      .0    .0    .0    .0    .0    .0    .0   4.4   5.4   6.9
61   1  160   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.7   4.4   5.0   6.1   7.6

61   1  161   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.8   6.0
61   1  162   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0    .0   3.9   4.7   5.3   6.2   7.0   8.0   8.7  10.4
61   1  163   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 33      .0    .0    .0    .0    .0    .0   4.4   5.2   6.3   7.8
61   1  164   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.4   5.1   6.5
61   1  165   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.8   4.5   5.1   6.0   7.4
61   1  166   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.7   4.5   5.3   6.2   7.6
61   1  167   1  1  1   21 23 24    0  0  0  0  0  0  0  0  0  0    28.8  29.2  29.6  30.3  30.8  31.0  31.1  31.3  31.4  31.6
61   1  168   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0   4.0   4.7   5.4   6.6   7.6   8.4   9.8
61   1  169   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   4.3   5.1   5.9   6.5   7.2   8.4
61   1  170   1  1  2   22 24 34    0  0  0  0  0  0  0  0  0  0    28.4  28.8  29.2  29.8  30.1  30.5  30.5  30.5  30.7  30.8

61   1  171   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.8   5.8   7.0
61   1  172   1  1  1   1X 1X 10    0  0  0  0  0  0  0  3  3  3      .0    .0    .0    .0    .0   3.6   4.4   5.2   6.3   7.9
61   1  173   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.1   5.0   5.9   7.2
61   1  174   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.2   4.9   6.2
61   1  175   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   3.8   4.5   5.2   6.9
61   1  176   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   4.1   5.0   6.1   6.9   7.6   8.8
61   1  177   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  3  3      .0    .0    .0    .0    .0    .0   4.0   4.7   5.4   6.9
61   1  178   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.8   5.5   6.9
61   1  179   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.6   4.5   5.3   6.2   7.8
61   1  180   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.7   6.0

61   1  181   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   3.9   4.6   5.3   6.6
61   1  182   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.6   4.5   5.3   6.9   8.3
61   1  183   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0 33 33      .0    .0    .0    .0    .0    .0   4.0   4.7   5.4   6.9
61   1  184   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.7   6.0
61   1  185   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.4   5.1   6.5
61   1  186   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   3.5   4.6   6.0   7.4
61   1  187   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   3.8   4.7   5.9   7.3
61   1  188   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.1   5.4   6.4   7.9
61   1  189   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0 33 33      .0    .0    .0    .0    .0    .0   4.2   5.0   6.0   7.5
61   1  190   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   4.9   6.2
```

61	1	191	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.7	4.7	5.7	6.8	8.3
61	1	192	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.5
61	1	193	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.9	6.4
61	1	194	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.3	4.8	5.4	6.3	6.9	7.3	8.9
61	1	195	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	14	14	.0	.0	.0	.0	.0	.0	.0	4.5	5.2	6.8
61	1	196	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	4.9	5.5	6.8
61	1	197	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	4.9	6.2
61	1	198	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.9	4.6	5.4	6.6
61	1	199	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	.0	.0	.0	4.1	4.9	5.9	7.3
61	1	200	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	4.9	6.2
61	1	201	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	4.9	5.8	7.1
61	1	202	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.9	4.6	5.2	6.7
61	1	203	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.9	4.7	5.3	6.8
61	1	204	1	1	1	21	22	22	64	64	62	0	0	0	0	0	0	0	23.8	24.5	25.2	25.9	26.4	26.9	27.0	27.5	27.8	28.4
61	1	205	1	1	1	20	22	24	3	3	3	3	0	0	0	62	0	0	22.8	23.7	24.6	25.4	26.2	26.5	26.7	27.1	27.3	27.4
61	1	206	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.5
61	1	207	1	1	2	20	22	24	0	0	0	0	0	0	0	0	0	0	19.3	20.2	21.2	22.0	22.3	23.0	23.2	23.3	23.5	23.5
61	1	208	1	1	2	21	22	22	0	4	0	0	0	0	0	0	0	0	17.6	18.1	18.7	19.1	19.6	20.0	20.3	20.6	21.0	21.9
61	1	209	2	2	2	32	32	32	0	62	2	0	30	30	62	23	23	0	19.4	19.8	20.2	20.6	21.2	21.5	21.8	22.1	22.4	23.1
61	1	210	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.6	4.6	5.5	6.7	7.5	8.3	9.2
61	1	211	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.0	5.1	6.1	7.1	8.1	9.0	10.5
61	1	212	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.1	6.2	7.0	8.2
61	1	213	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.5	5.9	7.1
61	1	214	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.9	6.1
61	1	215	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	4.3	5.2	6.7
61	1	216	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.7	4.7	5.7	6.7	7.7	8.1	9.1
61	1	217	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.4	6.9	8.1
61	1	218	1	1	1	10	10	10	0	0	0	0	0	0	0	0	0	0	.0	4.1	5.1	6.1	7.7	8.9	9.7	10.5	11.2	12.6
61	1	219	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.9	6.0
61	1	220	1	1	2	24	23	32	4	3	3	0	3	14	30	3	3	3	21.4	21.4	21.4	21.5	21.7	22.0	22.1	22.2	22.3	23.6
61	1	221	1	1	1	22	22	24	0	65	0	0	0	14	0	[illegible]	0	0	19.4	20.0	20.[illegible]	21.0	21.3	21.8	22.0	22.3	22.5	22.7
61	1	222	1	1	2	22	24	33	0	65	0	0	0	14	30	30	0	0	20.7	21.1	21.5	21.7	22.1	22.3	22.3	22.4	22.6	22.8
61	1	223	1	1	1	22	23	24	2	2	2	2	30	0	30	2	0	0	21.5	21.7	21.[illegible]	22.2	22.5	22.8	22.8	23.0	23.0	23.2
61	1	224	1	1	2	22	23	34	0	0	52	0	41	30	31	30	0	0	23.7	24.0	24.3	24.6	24.8	25.0	25.1	25.3	25.3	25.7
61	1	225	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.3	5.6	6.5	7.0
61	1	226	1	1	1	20	21	22	0	0	0	0	0	0	30	0	0	0	22.7	23.5	24.3	25.1	25.7	26.5	27.0	27.4	27.9	28.5
61	1	227	1	1	1	21	22	22	2	2	2	2	0	14	30	2	0	0	14.7	15.1	15.8	16.1	16.7	17.2	17.4	17.8	18.3	19.1
61	1	228	2	2	2	33	33	34	0	0	52	0	0	0	0	0	0	0	24.3	24.6	24.9	25.1	25.3	25.6	25.7	25.8	25.9	26.2
61	1	229	2	2	2	32	33	32	0	0	52	0	0	0	0	0	0	0	20.8	21.2	21.6	22.0	22.4	22.6	22.9	23.1	23.4	24.0
61	1	230	1	1	1	21	23	23	0	0	0	0	0	0	30	0	0	0	20.8	21.3	21.8	22.3	22.9	23.1	23.2	23.5	23.7	24.1
61	1	231	1	1	1	21	23	23	4	4	0	0	0	0	0	30	0	0	20.6	21.2	21.8	22.2	22.8	23.0	23.2	23.4	23.6	24.1
61	1	232	2	2	2	33	34	34	0	0	0	0	0	0	31	30	0	0	16.8	17.1	17.4	17.7	17.9	18.1	18.1	18.2	18.2	18.3
61	1	233	1	1	1	22	23	23	0	0	0	0	0	3	30	30	0	0	23.9	24.4	24.9	25.0	25.6	26.0	26.1	26.3	26.4	26.9
61	1	234	1	1	2	22	22	33	0	0	0	0	0	0	30	30	0	0	24.0	24.5	25.0	25.3	25.8	26.1	26.3	26.6	26.8	27.2
61	1	235	1	1	1	20	22	22	0	0	0	0	0	0	0	0	0	0	22.1	23.0	23.9	24.7	25.3	25.8	26.2	26.6	26.9	27.8
61	1	236	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.2	6.3	7.8
61	1	237	1	1	1	10	10	11	0	0	0	0	0	0	0	0	0	0	.0	4.1	5.4	6.7	7.8	8.7	9.4	10.1	10.8	12.1
61	1	238	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.4	6.7
61	1	239	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	5.3	6.6
61	1	240	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.6	6.3	7.0	7.6
61	1	241	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	5.9	7.1	7.8	8.4	10.0
61	1	242	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.2	6.7
61	1	243	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	5.0	6.5
61	1	244	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.3	5.1	6.2	7.5
61	1	245	2	2	2	33	34	34	62	62	52	0	52	52	52	52	52	90	25.7	25.8	25.9	26.1	26.4	26.5	26.5	26.6	26.7	26.7
61	1	246	1	1	2	23	24	34	3	3	3	3	3	42	43	43	43	93	20.6	20.8	21.0	21.2	21.4	21.5	21.5	21.5	21.5	21.5
61	1	247	2	2	2	43	44	4X	60	9	52	9	9	9	9	9	90	0	22.3	22.9	23.1	23.4	23.4	23.4	23.5	23.5	23.5	.0
61	1	248	2	2	0	43	44	44	60	9	9	9	9	9	9	91	0	0	38.5	38.7	39.0	39.2	39.3	39.3	39.3	39.3	.0	.0
61	1	249	2	2	2	44	44	44	9	9	9	9	30	30	30	30	52	92	26.0	26.2	26.4	26.5	26.5	26.9	26.9	26.9	26.9	26.9
61	1	250	2	0	0	4X	44	44	52	52	92	0	0	0	0	0	0	0	19.7	19.8	19.8	.0	.0	.0	.0	.0	.0	.0
61	1	251	2	2	2	32	34	34	0	0	0	0	30	31	31	31	32	98	23.4	23.8	24.2	24.6	24.7	24.8	24.8	24.8	24.8	24.8
61	1	252	2	2	0	33	3X	44	9	9	62	9	9	9	90	0	0	0	26.7	26.9	27.1	27.1	27.3	27.4	27.4	.0	.0	.0

TABLE 1.2:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	2	1	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.5	6.1
61	2	2	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.3	6.0
61	2	3	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.5
61	2	4	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.7	5.2	7.1
61	2	5	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.5
61	2	6	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.4	5.2	6.0	7.4
61	2	7	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.7	5.2	7.1
61	2	8	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	3.7	4.5	5.3	6.0	7.6
61	2	9	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.0	6.9
61	2	10	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.8	5.3	7.2
61	2	11	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.8	4.5	5.3	6.0	6.7	7.4	9.5
61	2	12	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.7	4.5	5.3	6.0	6.9	8.2
61	2	13	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.5	6.1
61	2	14	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.4
61	2	15	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.9	6.5
61	2	16	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.2	7.8
61	2	17	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.8	5.3	7.3
61	2	18	2	2	2	42	42	43	0	0	0	0	0	0	0	0	0	14	32.4	33.0	33.6	34.2	34.4	34.9	35.0	35.4	35.5	35.8
61	2	19	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.6
61	2	20	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.5	6.1
61	2	21	1	1	1	10	10	10	0	0	0	0	0	0	0	0	0	0	.0	4.0	4.9	5.9	6.9	7.9	8.9	9.9	11.1	13.3
61	2	22	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	3.8	4.5	5.3	6.0	6.7	6.8	8.1
61	2	23	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.7	6.2
61	2	24	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.9	4.5	5.2	5.8	6.4	7.0	7.7	9.0
61	2	25	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.9	4.5	5.2	5.8	6.5	7.2	8.0	9.1
61	2	26	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.4	5.2	5.6	6.4	7.0	7.7	9.0
61	2	27	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.8	4.6	5.3	6.0	7.0	7.7	9.5
61	2	28	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.7	6.2
61	2	29	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	52	.0	.0	.0	.0	4.4	5.3	6.7	7.5	8.3	9.9
61	2	30	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.4	5.2	6.0	7.4

```
61  2   31   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  3.7  4.5  5.4  6.2  7.0  7.9
61  2   32   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.0  4.9  5.5  6.3  7.2
61  2   33   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.0  4.9  5.5  6.3  7.2
61  2   34   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.3  5.0  5.9  6.8
61  2   35   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.8  4.5  6.0
61  2   36   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0   .0  3.6  4.5  5.4  6.3  7.1  7.9  9.2 11.1
61  2   37   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.0  5.2  6.0  6.8  7.7
61  2   38   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.1  5.3  6.1  6.9  7.8
61  2   39   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0  4.3  5.4  6.2  7.0  7.7  8.5 10.0
61  2   40   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.2  5.4  6.2  7.0  7.9

61  2   41   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.3  5.0  6.5
61  2   42   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.0  4.8  5.6  6.4  7.3
61  2   43   1  1  1   1X 1X 12    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.6  5.4  6.0
61  2   44   1  1  1   1X 11 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.1  5.0  5.9  6.2  7.3  8.8
61  2   45   1  1  1   10 10 10    0  0  0  0  0  0  0  0  0  0     4.0  4.8  5.6  6.4  7.2  8.0  8.9 10.0 11.0 13.1
61  2   46   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  5.0  6.6
61  2   47   1  1  1   1X 11 10    0  0  0  0  0  0  0  0  0  0      .0   .0  3.8  4.5  5.3  6.0  6.7  7.0  8.0  9.3
61  2   48   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.8  6.4
61  2   49   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.8  5.2  6.8
61  2   50   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.2  5.0  5.9  6.7  7.6  9.3

61  2   51   1  1  2   21 22 30    0  0  0  0  0  0  0  0  0  0    18.6 19.5 20.4 21.0 21.3 21.5 21.8 22.2 22.8 24.5
61  2   52   1  1  1   24 20 23    0  0  0  0  0  0  0  0  0  0    25.6 25.2 26.8 27.4 22.7 28.1 28.4 28.5 28.7 29.1
61  2   53   1  1  2   20 22 34    0  0 34 14  0  9  0  0 60 52    22.7 28.8 29.9 30.8 31.4 31.9 32.1 32.5 32.7 32.9
61  2   54   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.3  5.2  6.0  6.8  7.5  8.9
61  2   55   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.0  4.8  5.7  6.6  7.5  9.2
61  2   56   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.8  5.2  6.8
61  2   57   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0  4.0  4.9  5.6  6.4  7.2  8.0 10.3
61  2   58   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.7  5.1  6.4
61  2   59   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0 14      .0   .0   .0   .0  4.3  5.2  6.0  6.8  7.5  8.8
61  2   60   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.0  4.9  5.6  6.2  7.1

61  2   61   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  3      .0   .0   .0   .0   .0   .0   .0  4.0  4.7  6.0
61  2   62   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.8  6.1
61  2   63   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.0  4.7  5.4  6.1  6.8  8.1
61  2   64   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.8  6.1
61  2   65   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.1  4.9  5.9  6.9  8.9
61  2   66   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.9  5.7  7.7
61  2   67   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.2  5.1  5.9  7.9
61  2   68   1  1  1   21 23 24    0  0 10  0  0  0 31 32  0  9    18.4 19.2 19.8 20.4 21.1 21.5 21.6 21.7 21.7 21.8
61  2   69   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.3  5.1  7.0
61  2   70   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  3      .0   .0   .0   .0   .0   .0  4.2  5.2  6.2  8.2

61  2   71   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0 14      .0   .0   .0   .0   .0   .0   .0   .0  4.3  6.0
61  2   72   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.8  4.5  6.2
61  2   73   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.4  6.1
61  2   74   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.7
61  2   75   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.4  6.1
61  2   76   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0 14      .0   .0   .0   .0   .0   .0   .0   .0  4.4  6.1
61  2   77   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.4  6.1
61  2   78   1  1  1   20 22 23    0 20  0  0  0 22 30 22 23 52    16.2 17.1 18.0 18.8 19.5 20.1 20.5 20.9 21.2 21.6
61  2   79   1  1  1   20 20 21    0  0  0  0  0  0  0  0  0  0    16.4 17.5 18.8 20.4 20.7 22.3 23.1 24.1 24.8 26.0
61  2   80   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.9

61  2   81   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.3  6.0
61  2   82   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.8  4.5  6.2
61  2   83   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  4.9  6.6
61  2   84   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.2  5.0  5.8  6.6  7.4  8.4
61  2   85   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.8  5.6  7.3
61  2   86   1  1  1   10 10 12    0  0  0  0  0  0  0  0  0  0      .0  3.5  4.6  6.1  7.1  7.9  9.3  9.4  9.7 10.7
61  2   87   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  4.9  6.6
61  2   88   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.4  5.3  6.4  8.4
61  2   89   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  4.7  6.4
61  2   90   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.2  6.2

61  2   91   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.0  5.0  6.4  7.8  8.5  9.9
61  2   92   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  4.9  6.9
61  2   93   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  3.6  4.5  5.6  7.4
61  2   94   1  0  0   1X 44 44    0  0  0  0  0  0  0  0  0  0      .0   .0  4.7  8.0   .0   .0   .0   .0   .0   .0
61  2   94   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0  4.7  6.6  7.7  8.6  9.2  9.9 10.4 11.6
61  2   95   1  1  1   1X 10 12    0  0  0  0  0  0  0  0  0  0      .0   .0  3.8  5.5  6.4  7.3  7.9  8.5  9.0  9.9
61  2   96   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 14      .0   .0   .0   .0   .0   .0   .0  4.0  4.7  6.3
61  2   97   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.6  4.5  6.3
61  2   98   1  1  1   12 12 11    0  0  0  0  0  0  0  0  0  0      .0  4.0  4.7  4.9  5.1  5.3  5.5  6.2  6.9  7.9
61  2   99   1  1  1   1X 11 11    0  0  0  0  0  0  0  0  0  0      .0   .0  4.0  5.0  6.4  7.2  7.8  8.4  9.2 10.4

61  2  100   1  1  1   1X 11 12    0  0  0  0  0  0  0  0  0 52      .0   .0  4.5  5.8  6.6  7.5  8.0  8.4  8.6  9.4
61  2  101   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  4.7  6.3
61  2  102   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.3  5.6  6.6  8.6
61  2  103   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.9  5.8  7.6
61  2  104   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.7  5.6  7.3
61  2  105   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  3      .0   .0   .0   .0   .0   .0   .0  4.3  5.2  7.0
61  2  106   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  4.5  6.7
61  2  107   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.9  6.7
61  2  108   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.1  4.9  5.9  7.5
61  2  109   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.0  4.7  5.7  6.5  7.8

61  2  110   1  1  1   1X 11 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0  4.0  5.2  6.0  6.6  7.1  7.8  8.6
61  2  111   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.3  5.1  6.9
61  2  112   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.9  6.7
61  2  113   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 14      .0   .0   .0   .0   .0   .0  4.0  4.9  5.6  7.3
61  2  114   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.0  4.8  6.5  7.7  8.7  9.9
61  2  115   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  5.6  7.3
61  2  116   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.7  7.4
61  2  117   1  1  1   1X 10 12    0  0  0  0  0  0  0  0  0  0      .0   .0   .0  3.8  4.5  5.4  6.2  7.0  7.6  8.4
61  2  118   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.3  5.0  7.0
61  2  119   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.6  5.3  7.2

61  2  120   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  3.6  4.5  5.2  7.2
61  2  121   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.3  5.2  6.1  7.9
61  2  122   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.9  5.9  6.8
61  2  123   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.7  4.5  6.1
61  2  124   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0  4.0  4.8  6.4  7.3  8.0  8.8  9.4 10.9
61  2  125   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0  4.0  4.7  5.9  6.7  7.3  7.8  8.9
61  2  126   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.8  4.5  6.0
61  2  127   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.3  5.2  6.5  8.4
61  2  128   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  3.5  4.5  5.6  7.4
61  2  129   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0 33      .0   .0   .0   .0   .0   .0  4.1  4.9  5.9  6.8
```

```
61  2  130   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0 14      .0    .0    .0    .0    .0    .0    .0   4.4   5.4   6.4
61  2  131   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.2   5.2   6.1
61  2  132   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  2      .0    .0    .0    .0    .0    .0   3.5   4.5   5.5   6.4
61  2  133   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.2   5.3   6.2   8.4
61  2  134   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.1   4.9   6.1
61  2  135   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.4   5.2   6.5
61  2  136   1  1  1   1X 11 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   4.0   4.8   5.5   6.0   6.5   7.5
61  2  137   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   4.3   5.0   5.8   6.7   7.3   8.3
61  2  138   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.2   4.9   6.1
61  2  139   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.8   5.6   7.5

61  2  140   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.9
61  2  141   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.1   5.4   7.2
61  2  142   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.2   5.3   7.3
61  2  143   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.8   6.1
61  2  144   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  3      .0    .0    .0    .0    .0    .0    .0   4.3   5.1   6.3
61  2  145   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.1   4.8   6.0
61  2  146   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.7   6.0
61  2  147   1  1  1   10 10 11    0  0  0  0  0  0  0  0  0  0      .0   4.1   5.0   6.7   7.8   8.7   9.2  10.1  10.7  12.0
61  2  148   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 34      .0    .0    .0    .0    .0    .0    .0   4.0   4.8   6.1
61  2  149   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.6   5.3   6.3

61  2  150   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.2   5.0   6.5
61  2  151   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   3.8   4.5   6.0
61  2  152   2  2  2   31 33 33    0  0  0  0  0  0  0  0  0  0    23.6  24.1  24.6  25.5  25.7  26.1  26.2  26.3  26.5  26.9
61  2  153   2  2  2   42 43 44    0  0 62 60  0  0  0  0  0  0    33.4  33.8  34.2  34.5  34.6  34.8  34.9  35.1  35.2  35.3
61  2  154   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.7   5.4   6.9
61  2  155   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.7   6.2
61  2  156   2  2  2   43 44 44    0  0  0  0  0  0  0  0  0  0    28.2  28.4  28.6  28.9  29.1  29.2  29.2  29.3  29.3  29.4
61  2  157   2  2  2   44 44 44    0  0  0  0  0  0  0  0  0  0    18.2  18.4  18.4  18.6  18.6  18.7  18.7  18.8  18.8  18.9
61  2  158   2  2  2   43 44 44    0 60 62 64  0  0  0  0  0  0    23.5  23.7  23.9  24.1  24.2  24.3  24.3  24.3  24.4  24.4
61  2  159   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.2   4.9   5.7   7.0

61  2  160   1  1  1   20 21 21    0  0  0  0  0 64  0  0  0  0    11.0  12.6  13.3  14.4  15.1  15.9  16.5  17.0  17.6  18.8
61  2  161   1  1  1   21 22 23    2  2  2  2  2  2  2  2  2  2    15.1  15.8  16.5  16.9  17.3  17.8  18.1  18.5  18.7  19.1
61  2  162   1  1  1   21 22 22    0 73  0  0  0  0  0  0  0  0    11.5  12.1  12.7  13.4  13.9  14.4  14.6  15.2  15.4  16.1
61  2  163   1  1  1   24 24 24    0 74  0  0  0  0  0  0  0 91    22.3  22.6  22.6  22.6  22.7  22.7  22.7  22.7  22.8  22.8
61  2  164   1  1  1   23 22 22    0  0  0  0  0  0  0  0  0  0    13.8  14.0  14.2  14.3  14.7  15.1  15.3  15.8  16.1  16.6
61  2  165   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.0   4.8   5.8   6.8   8.8
61  2  166   2  2  2   33 34 34    0  0  0  0  0  0  0 13  0  0    25.0  25.2  25.4  25.7  25.8  25.8  26.0  26.0  26.0  26.0
61  2  167   2  2  2   44 44 44    0  0  0  0  0  0  0  0  0 52    30.0  30.2  30.3  30.4  30.5  30.6  30.6  30.6  30.6  30.6
61  2  168   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.2   4.8   6.6
61  2  169   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   4.9   6.7

61  2  170   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.6   6.1
61  2  171   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.1   4.9   6.9
61  2  172   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  3      .0    .0    .0    .0    .0    .0    .0   4.4   5.2   7.0
61  2  173   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.6   6.1
61  2  174   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   4.9   6.0
61  2  175   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.1   4.7   5.2   6.6
61  2  176   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  3      .0    .0    .0    .0    .0   3.7   4.5   5.3   6.1   7.9
61  2  177   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.4   5.0   6.2
61  2  178   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.4   5.3   6.0   7.4
61  2  179   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.0   4.8   5.8   6.8   8.8

61  2  180   1  1  1   1X 1X 11    0  0  0  0  0  0  0  3  3  3      .0    .0    .0    .0    .0    .0   4.0   4.5   5.1   6.3
61  2  181   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   5.0   6.0   8.0
61  2  182   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.1   4.8   5.5   6.5
61  2  183   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  3  3      .0    .0    .0    .0    .0    .0   4.2   5.1   6.0   7.8
61  2  184   1  1  1   1X 1X 10    0  0  0  0  0  0 14 14 14 14      .0    .0    .0    .0    .0   4.0   4.9   5.9   6.9   8.9
61  2  185   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.0   4.8   5.8   6.8   8.8
61  2  186   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.4   5.4   6.4   7.4   9.4
61  2  187   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0   4.1   5.1   6.1   7.1   8.1   8.8   9.9
61  2  188   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.5
61  2  189   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.7   5.4   6.9

61  2  190   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.1   4.8   5.5   7.0
61  2  191   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.5   5.2   6.7
61  2  192   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.4
61  2  193   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.4
61  2  194   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.1   4.8   6.2
61  2  195   1  1  1   1X 1X 10    0  0  0  0  0  0  0 14  0  0      .0    .0    .0    .0    .0    .0    .0   4.4   5.1   6.5
61  2  196   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0 14 14      .0    .0    .0    .0    .0    .0    .0   4.4   5.1   6.5
61  2  197   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.7   6.1
61  2  198   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.1   4.5   5.2   6.7
61  2  199   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0 52      .0    .0   3.9   4.8   5.8   6.7   7.7   8.6   9.3  10.5

61  2  200   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.2   5.2   6.2   8.2
61  2  201   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.4   5.0   6.3   7.6   8.9
61  2  202   1  1  1   1X 1X 11    0  0  0  0  0  0  2  2  0  0      .0    .0    .0    .0    .0    .0   4.0   4.6   5.2   6.4
61  2  203   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  2  2      .0    .0    .0    .0    .0    .0   4.5   5.3   6.0   7.7
61  2  204   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.4   5.0   5.8   7.5
61  2  205   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.4   5.0   5.7   7.4
61  2  206   2  2  2   34 34 34    0  0  0  0  0  0  0  0  0  0    28.5  28.6  28.7  28.8  28.9  29.0  29.0  29.1  29.3  29.4
61  2  207   1  1  1   1X 11 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0   4.4   5.0   5.6   6.2   6.9   7.9   9.7
61  2  208   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.3   4.9   6.1   7.1
61  2  209   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.5   6.4

61  2  210   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.4   5.1   6.1   7.1   8.1
61  2  211   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.4   5.2   6.0   7.5
61  2  212   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.1   4.7   5.7   6.7   8.7
61  2  213   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.4   5.0   6.3
61  2  214   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.3   5.2   6.0   7.3
61  2  215   2  2  2   31 32 33    3  3  3  3  3  3  3  3  3  3    23.6  24.4  25.2  25.8  26.3  26.7  26.8  27.2  27.3  27.6
61  2  216   2  2  2   20 22 23    0  0  0  0  0  0  0  0  0  0    24.7  25.8  26.9  27.9  28.5  29.0  29.4  29.5  29.6  30.1
61  2  217   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.7   6.0
61  2  218   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.1   6.7
61  2  219   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.5   5.1   6.3

61  2  220   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.4   5.2   6.0   7.8
61  2  221   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.2   5.0   5.9   7.5
61  2  222   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  3      .0    .0    .0    .0    .0    .0   3.7   4.5   5.3   6.9
61  2  223   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.2   5.0   5.9   6.9   8.9
61  2  224   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.3
61  2  225   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.4   5.3   6.3   8.3
61  2  226   1  1  1   1X 11 11    0  0  0 33 33  3  3  3  3  3      .0    .0    .0   4.2   5.2   6.0   6.6   7.2   8.0   9.0
61  2  227   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.3   4.8   5.4   6.0   7.3
61  2  228   2  2  2   42 43 43    0 66  0  0  0  0  0  0  0  0    16.7  17.2  17.7  17.8  18.2  18.4  18.6  18.9  19.1  19.6
61  2  229   2  2  2   44 44 44    0 60  9 66  9  9  0  0  0  0    21.9  22.0  22.1  22.2  22.3  22.4  22.4  22.6  22.7  23.0
```

```
61    2   230    2  2  2    43 43 44     0  0  0  0  0  0  0  0  0  0     22.8  23.1  23.3  23.5  23.8  24.1  24.2  24.3  24.3  24.5
61    2   231    2  2  2    44 44 44     0  5  2  0  0  0  0  0  0  0     22.9  23.2  23.2  23.3  23.4  23.4  23.5  23.5  23.7  23.8
61    2   232    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0   4.2   4.7   5.2   5.9   7.1
61    2   233    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.4   5.3   6.3   8.3
61    2   234    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.0   4.6   5.4   7.0
61    2   235    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.0   4.7   5.7   7.7
61    2   236    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0   4.4   5.4   6.4   7.4   9.4
61    2   237    1  1  1    1X 1X 10     0  0  0  0  0  0 14 14 14 14       .0    .0    .0    .0    .0    .0   4.4   5.2   6.0   7.5
61    2   238    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.0   4.6   6.0
61    2   239    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.4   5.0   6.3

61    2   240    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.3   4.9   6.2
61    2   241    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.2   5.0   6.8
61    2   242    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.4   5.2   7.0
61    2   243    1  1  1    1X 1X 10     0  0  0  0  0  0  0 14 14 14       .0    .0    .0    .0    .0    .0    .0   4.2   5.0   6.8
61    2   244    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.4   5.0   6.2
61    2   245    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.1
61    2   246    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.4   5.0   6.8
61    2   247    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.0   4.8   6.0
61    2   248    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.0   4.6   5.4   7.3
61    2   249    1  0  0    2X 44 44     0  0  0  0  0  0  0  0  0  0     19.7  20.7  21.7  22.1    .0    .0    .0    .0    .0    .0

61    2   249    1  1  1    10 22 22     0  0  0  0  0  0  0  0  0  0     19.7  20.7  21.7  22.7  23.3  23.8  24.3  24.6  25.2  25.9
61    2   250    1  1  1    22 22 23     0  0  0  0  0 31 31  0  0  0     22.4  23.1  23.7  24.2  24.5  25.0  25.0  25.4  25.5  25.9
61    2   251    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0 33 33       .0    .0    .0    .0    .0    .0    .0   4.2   5.0   6.6
61    2   252    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0   4.0   4.6   5.4   6.0   7.2
61    2   253    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0   4.2   4.8   5.4   6.0   6.9
61    2   254    2  2  0    44 44 44     9  9  2 33 70 60 70 90  0  0     34.2  34.3  34.3  34.4  33.6  33.6  33.7  33.7    .0    .0
61    2   255    2  2  0    44 4X 44     9  9  4 31 31 31 92  0  0  0     20.9  21.1  21.1  21.2  21.2  21.3  21.3    .0    .0    .0
61    2   256    2  2  0    44 44 44     0  0  0  0  0  0  0 90  0  0     27.8  28.0  28.2  28.4  28.4  28.6  28.6  28.6    .0    .0
61    2   257    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.2   4.7   5.4   6.4
61    2   258    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   3.6   4.3   5.0   6.4

61    2   259    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.3   4.9   5.6   6.7
[illegible] E 1.3:
||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||
     SUB
PLOT PLOT TREE    AGE        AGE-
NO.  NO.  NO.    CLASS       VIGOR            TREE CONDITION CODE                          D.B.H. (INCHES)
                20 40 60    I II III    1920 25 30 35 40 45 50 55 60 70     1920    25    30    35    40    45    50    55    60    70
------------------------------------------------------------------------------------------------------------------------------------

61    3     1    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.4   5.3   7.1
61    3     2    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.4   5.3   7.1
61    3     3    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.0   4.7   6.3
61    3     4    1  1  1    1X 1X 1X     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0    .0   4.4   6.1
61    3     5    1  1  1    1X 1X 10     0  0  0  0  0  0 14 14 14 14       .0    .0    .0    .0    .0    .0   3.6   4.5   5.4   7.1
61    3     6    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.0   4.6   4.9   6.5
61    3     7    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.4   5.2   6.8
61    3     8    1  1  1    1X 1X 1X     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0    .0   4.4   6.1
61    3    91    0  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   3.9   4.9   5.9   7.9
61    3    10    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.0   5.0   6.0   8.0

61    3    11    1  1  1    1X 1X 10     0  0  0  0  0  0  2  2  2  2       .0    .0    .0    .0    .0    .0   4.2   5.0   5.9   7.6
61    3    12    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.0   4.7   6.3
61    3    13    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.2   4.8   6.4
61    3    14    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.3   4.9   6.7
61    3    15    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.1   5.1   6.1   8.1
61    3    16    1  1  1    1X 1X 10     0  0  0  0  0  0  0  3  3  3       .0    .0    .0    .0    .0    .0    .0   4.0   4.7   6.2
61    3    17    1  1  1    10 10 20     0  0  0  0  0  0  5  0  0  0       .0   4.0   6.3   8.3   9.9  10.9  11.8  12.6  13.2  14.8
61    3    18    1  1  1    1X 10 20     0  0  0  0  0  0  0  0  2  2       .0    .0    .0    .0   4.0   6.5   8.0   9.4  11.0  12.7
61    3    19    1  1  1    20 20 20     0  0  0  0  0  0  0  0 30  0     15.4  16.7  18.3  21.0  21.2  22.3  23.6  24.0  24.8  26.2
61    3    20    1  1  1    22 22 24     0  0  0  0  0  0  0  0  0  0     17.3  17.7  18.1  18.5  18.7  19.2  19.4  19.6  19.6  19.7

61    3    21    1  1  1    13 23 22    14 14 14 14 31 31 14 14  0  0     11.0  11.2  11.3  11.6  11.9  12.2  12.6  12.6  12.9  13.5
61    3    22    1  1  1    23 24 24     0 11  0  0 30  0  0  0  0  0     14.7  14.8  14.9  15.3  15.4  15.4  15.5  15.6  15.6  15.7
61    3    23    1  1  1    1X 1X 10     0  0  0  0  0  0  0  2  2  2       .0    .0    .0    .0    .0    .0   3.7   4.7   5.7   7.7
61    3    24    1  1  1    1X 1X 1X     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0    .0   4.4   6.1
61    3    25    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.4   5.1   6.8
61    3    26    1  1  1    22 23 24     9  9  9  9 31 31 31 31 31 31     26.9  27.4  27.9  28.6  28.6  28.9  29.0  29.1  29.1  29.3
61    3    27    1  1  1    20 22 24     0  0  0  0  0 14  0  0  0  0     14.5  15.5  16.5  17.2  17.6  18.4  18.7  19.0  19.2  19.4
61    3    28    1  1  1    10 10 11     0  0  0  0  0  0  5  0  0  0       .0   3.8   5.8   7.2   8.1   9.0   9.6  10.3  10.9  12.0
61    3    29    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   3.6   4.5   6.3
61    3    30    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.0   4.6   6.1

61    3    31    1  1  1    21 22 23     0  0  0  0  0  0  0  0  0  0     17.5  18.3  19.1  19.7  20.0  20.4  20.7  20.9  21.1  21.6
61    3    32    1  1  1    20 22 22     0  0  0  0  0  0  0  0  0  0     18.8  20.0  21.6  22.8  23.5  24.2  24.6  24.9  25.3  26.1
61    3    33    1  1  1    20 21 22     0  0  0  0  0  0 30  0  0  0     15.0  15.7  16.4  17.3  17.9  18.3  18.9  19.5  19.8  20.9
61    3    34    1  1  2    20 21 32     0  0  0  0  0  0  0  0  0  0     20.4  21.5  22.6  23.5  24.3  25.1  25.5  25.8  26.3  27.0
61    3    35    1  1  1    22 22 24     3  3  3  3  3  3  3  3 30  3     18.5  18.8  19.1  19.6  19.9  20.5  20.9  21.2  21.4  21.4
61    3    36    1  1  1    21 21 23     0  0  0  0  0  0  0  0  0  0     18.1  18.8  19.5  20.1  20.5  21.3  21.8  22.5  23.0  23.0
61    3    37    1  1  1    22 23 24     0  0  0  0  0  0  0  0  0  0     22.4  23.1  23.3  24.1  24.2  24.3  24.5  24.9  25.0  25.1
61    3    38    1  1  1    21 22 23     3  3  3  3  3  3 30  3  3  3     20.6  21.1  21.7  22.1  22.7  23.0  23.3  23.6  23.9  24.4
61    3    39    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   3.8   4.[illegible]   5.8   7.8
61    3    40    1  1  1    20 21 22     0  0  0  0  0  0  0  0  0  0     18.9  19.9  20.9  21.9  22.5  23.2  23.7  24.2  24.6  25.4

61    3    41    1  1  1    1X 10 10     0  0 14  0  0 33 33  0  0  0       .0    .0   4.0   [illegible].0   7.0   8.1   8.9   9.5  10.3  11.9
61    3    42    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.5
61    3    43    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.2   5.3   7.3
61    3    44    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.3   5.2   6.9
61    3    45    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.2   5.0   6.6
61    3    46    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.3   5.3   7.3
61    3    47    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.3   5.1   7.1
61    3    48    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.2   5.2   7.2
61    3    49    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.0   4.8   6.4
61    3    50    1  1  1    22 22 24     0  0  0  0 30  0  0  0  0  0     15.4  15.8  16.0  16.4  16.6  17.1  17.2  17.5  17.5  17.8

61    3    51    1  1  1    22 23 24     0  0  0  0  0  0  0  0  0  0     16.8  17.3  17.8  18.0  18.2  18.6  18.8  18.8  19.0  19.0
61    3    52    1  1  1    21 21 23     0  0  0  0  0  0  0  0  0  0     18.4  19.1  19.7  20.3  20.9  21.2  22.2  22.4  22.5  22.8
61    3    53    1  1  1    21 22 22     0  0  0  0  0 33  0  0  0  0     16.3  16.9  17.5  18.2  18.9  19.8  20.2  20.2  20.5  21.0
61    3    54    1  1  1    21 22 23     0  0  0  0  0  0  0  0  0  0     16.3  16.8  17.3  18.0  18.4  19.1  19.2  19.4  19.7  19.8
61    3    55    1  1  1    10 22 21     0  0  0  0  0  0  0  0  0  0     10.3  10.6  11.4  12.3  13.2  13.9  14.0  14.3  14.8  15.8
61    3    56    1  1  1    21 22 22     0  0  0  0  0  0  0  0  0  0     14.1  14.7  15.3  15.8  16.5  17.0  17.3  17.7  18.0  18.9
61    3    57    1  1  1    20 22 23     0  0  0  0  0  0  0  0  0 52     20.4  21.2  22.0  22.5  23.3  23.7  23.8  24.2  24.4  24.9
61    3    58    1  1  1    12 23 24     0  0  0  0  0  0  0  0  0  0     11.3  11.5  11.7  12.1  12.3  12.7  12.8  13.[illegible]  13.1  13.2
61    3    59    1  1  1    22 22 22     0  0  0  0 40  0  0 20  0  0     18.1  18.5  18.8  19.4  19.8  20.3  20.7  21.[illegible]  21.4  22.2
61    3    60    1  1  1    22 22 24     0 13  0  0  0  0  0  0  0  0     17.4  17.6  18.0  18.4  18.7  19.1  19.3  19.5  19.5  19.9
```

```
61  3   61   1  1  1   24 24 22    0  0  0  0 31  0  0  0 30 52    22.4  22.6  22.8  23.0  23.0  23.0  23.1  23.1  23.9  24.4
61  3   62   1  1  1   21 22 22    0  0  0  0  0 14  0  0  0  0    16.8  17.6  18.4  18.9  19.7  20.0  20.6  21.1  21.6  22.3
61  3   63   1  1  1   10 20 22    0  0  0  0  0  0  0  0  0  0     9.9  10.9  11.9  13.0  13.1  14.9  15.5  16.0  16.6  17.4
61  3   64   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.3   5.3   6.3   8.3
61  3   65   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.6   4.5   5.4   7.9   9.0
61  3   66   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.8   4.6   5.4   7.8   8.8
61  3   67   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0   4.0   5.3   6.2   7.0   8.0   8.9   9.7  10.9
61  3   68   1  1  1   1X 11 11    0  0  0  0  0  0  0  0  0  0      .0    .0   4.0   5.3   6.7   7.1   7.8   8.7   9.4  10.5
61  3   69   1  1  1   1X 10 12    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   4.5   6.2   6.9   7.8   8.7   9.1
61  3   70   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0     4.6   5.4   6.5   6.7   7.2   7.6   7.8   8.0   8.4   8.9

61  3   71   1  1  1   11 12 12    0  0  0  0  0  0  0  0  0  0     4.2   4.8   5.6   6.4   6.9   7.4   7.8   8.2   8.6   9.3
61  3   72   1  1  1   10 12 13    0 33  0  0  0  0  0  0  0  0     4.4   4.5   5.4   6.2   6.7   7.3   7.6   7.9   8.2   8.6
61  3   73   1  1  1   10 11 13    0  0  0  0  0  0 30  0  3  0     4.5   6.0   7.5   8.7   9.2   9.8  10.4  10.8  11.0  11.4
61  3   74   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     4.2   4.7   6.2   7.4   8.1   8.7   9.2   9.8  10.2  10.9
61  3   75   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.9   6.9
61  3   76   1  1  1   1X 12 12    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   4.4   4.8   5.2   5.6   6.2   6.7
61  3   77   1  1  1   10 11 11    0 33  0  0  0  3  0  0  3  3      .0   4.5   6.2   7.2   8.1   8.7   9.3   9.7  10.1  11.2
61  3   78   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   4.8   5.6   6.4   7.2   8.0   8.9
61  3   79   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   3.6   4.6   5.6   7.6
61  3   80   1  1  1   10 11 11    0  0  0  0  0  0  0  0  0  0     4.5   5.5   6.9   8.2   8.9   9.6  10.3  10.9  11.4  12.5

61  3   81   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.2   5.0   5.9   6.7   8.3
61  3   82   1  1  1   10 11 11   33 33  0  0  0  0  0  0  0  0     7.3   8.6   9.5  11.0  11.9  12.4  13.0  13.6  14.2  15.5
61  3   83   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0 14 14      .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.6
61  3   84   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.2   5.0   5.9   7.0   8.7
61  3   85   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.4
61  3   86   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.7   6.1
61  3   87   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.2   5.0   5.9   7.0   8.7
61  3   88   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.4
61  3   89   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.1   4.9   5.8   5.9   7.5
61  3   90   1  1  1   1X 1Y 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.5   5.5   7.5

61  3   91   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   5.0   7.0
61  3   92   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 14      .0    .0    .0    .0    .0    .0    .0   4.0   5.0   7.0
61  3   93   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.0   4.6   5.1   6.1
61  3   94   1  1  2   20 22 23    0  0  0  0  0  0  0  0  0  0    29.1  29.9  30.8  31.5  32.0  32.7  32.8  33.1  33.1  33.8
61  3   95   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.4   5.0   5.9   6.5   8.1
61  3   96   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.9   4.9   5.9   7.9
61  3   97   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.2   5.0   6.5
61  3   98   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 33      .0    .0    .0    .0    .0    .0   3.6   4.6   5.6   7.6
61  3   99   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.2   5.0   6.8
61  3  100   1  1  1   23 24 24    0  0  0  0  0  0  0  0  0  0    15.0  15.4  15.8  16.0  16.1  16.1  16.1  16.2  16.3  16.4

61  3  101   1  1  1   10 21 22   33  9  0  0  0  0  0  0  0  0     8.7   9.5  10.6  11.8  12.4  12.9  13.5  14.0  14.4  15.1
61  3  102   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.1   5.0   6.6
61  3  103   1  1  1   23 24 24    0  0  0  0  0 14  0  4  0  0    12.7  13.1  13.4  13.7  13.8  14.1  14.2  14.2  14.3  14.5
61  3  104   1  1  1   21 23 23    0  0  0  0  0  0  0  0  0  0    25.0  25.6  26.1  26.7  27.1  27.5  27.7  27.9  28.0  28.4
61  3  105   1  1  1   22 23 20    0  0  0  0  0  0  0  0  0  0    20.0  20.6  21.1  21.5  21.8  22.0  22.1  22.3  22.4  25.7
61  3  106   1  1  1   22 23 24    0  0  0  0  0  0  0  0  0  0    22.5  23.0  23.5  24.0  24.4  24.6  24.9  25.1  25.4  25.5
61  3  107   1  1  1   22 22 22    0  0  0  0  0  0 22  0  0  0    20.3  20.8  21.3  21.9  22.2  22.8  23.1  23.4  23.6  24.3
61  3  108   1  1  1   22 22 23    3  3  3  3  3  3  3  3  3  3    16.5  17.0  17.5  18.0  18.4  18.9  19.1  19.4  19.5  20.0
61  3  109   1  1  2   22 23 34    0  0  0  0  0  0  0  0  0  0    24.8  25.3  25.7  26.3  26.5  26.9  27.1  27.1  27.3  27.5
61  3  110   1  1  1   21 22 22    0  0  0  0  0  0  0  0  0  0    13.1  13.7  14.3  15.1  15.6  16.2  16.6  17.0  17.5  17.8

61  3  111   1  1  1   21 21 24    0  0  0  0  0  0  0  0  0  0    20.0  20.5  21.0  21.8  22.2  22.7  22.9  23.8  23.9  24.1
61  3  112   1  1  1   22 22 22    0  0  0  0  0  0  0  0  0  0    12.9  13.3  13.8  14.3  14.7  15.1  15.4  15.5  15.8  16.3
61  3  113   1  1  1   20 20 22    0  0  0  0  0  0  0  0  0  0    14.4  15.3  16.2  17.1  18.0  18.9  19.7  20.3  20.7  21.6
61  3  114   1  1  1   22 22 24    0  0  0  0  0  0 31  0  0  0    15.6  15.0  16.4  16.9  17.2  17.5  17.7  18.0  18.2  18.4
61  3  115   1  1  1   22 24 24    0  0  0  0  0  0  0  0  0  0    11.3  11.7  12.1  12.2  12.5  12.5  12.5  12.6  12.6  12.9
61  3  116   2  2  2   31 33 34    0  0  0  0  0  0  0  0  0  0    22.1  22.6  23.1  23.6  24.1  24.5  24.8  24.9  25.0  25.2
61  3  117   2  2  2   30 32 33    0 66  0  0  0 14  0  0  0  0    17.8  18.8  19.8  20.2  21.0  21.3  21.6  21.8  21.9  22.5
61  3  118   2  2  2   34 34 34    0  9 65 52 52  0  0  0  0 90    18.9  18.8  18.8  18.9  18.9  18.9  18.9  19.0  19.0  19.0
61  3  119   2  2  2   33 34 34    0  0  0  0  0  0  0  0  0  0    29.8  30.2  30.5  30.7  30.8  31.1  31.1  31.2  31.3  31.4
61  3  120   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.5

61  3  121   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.4   5.2   6.9
61  3  122   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0    .0   4.2   6.0
61  3  123   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0    .0   4.0   6.2
61  3  124   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0    .0   4.2   6.0
61  3  125   1  1  1   10 10 21    0  0  0  0  0  0  0  0  0  0     5.9   6.9   8.7  10.3  11.3  12.3  13.0  13.9  14.7  15.9
61  3  126   1  1  1   11 11 11    0  0  0  0  0  0  0  0  0  0      .0   4.0   4.6   5.1   5.6   6.0   6.6   7.1   7.7   8.8
61  3  127   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0    .0   3.5   4.7   6.5   7.6   8.3   9.0  10.0  11.5
61  3  128   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   3.7   4.7   5.7   7.7
61  3  129   1  1  1   1X 1X 10    0  0  0  0  0  0  3  3  3  3      .0    .0    .0    .0    .0    .0   4.3   5.3   6.3   8.3
61  3  130   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.7   4.7   5.7   6.7   8.7

61  3  131   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   3.7   4.6   6.4
61  3  132   1  1  1   20 21 21    0  0  0  0  0  0  0  0  0  0    14.0  14.8  16.0  16.9  17.7  18.3  18.6  19.2  19.8  20.9
61  3  133   1  1  1   20 21 21    0  0  0  0  0  0  0  0  0  0    16.0  17.1  18.6  19.7  20.2  20.9  21.5  22.1  22.9  24.1
61  3  134   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.1   4.5   4.9   6.3
61  3  135   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   5.0   7.0
61  3  136   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.1   5.1   7.1
61  3  137   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 33      .0    .0    .0    .0    .0    .0    .0   4.0   4.6   6.3
61  3  138   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.1   4.9   6.6
61  3  139   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.6   4.6   5.6   6.6   8.6
61  3  140   1  1  1   1X 10 12    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   4.2   4.7   5.2   7.7   8.2   8.9

61  3  141   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0   3.5   4.6   5.8   6.9   8.0   9.6  11.4
61  3  142   1  1  1   1X 10 14    0  0  0  0  0  0  0  0  0  0      .0    .0   3.6   4.6   5.6   6.6   7.6   8.6   6.2   8.2
61  3  143   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   3.7   4.7   5.7   6.7   8.7
61  3  144   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   4.5   5.5   6.5   8.5
61  3  145   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.7
61  3  146   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   4.9   6.6
61  3  147   1  1  1   1X 1X 10    0  0  0  0  0  0  2  2  2  2      .0    .0    .0    .0    .0    .0   3.7   4.7   5.7   7.8
61  3  148   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   3.9   4.9   6.9
61  3  149   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   3.7   4.7   5.7   7.7
61  3  150   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0   4.0   4.8   5.6   6.4   8.0

61  3  151   1  1  1   10 10 11    0  0  0  0  0  0  0  0  0  0      .0   4.0   5.2   6.8   8.0   8.9   9.7  10.5  11.2  12.5
61  3  152   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.0   4.8   6.5
61  3  153   1  1  1   10 21 22    0  0  0  0  0  0 60  0  0  0     7.6   9.1  10.7  12.0  12.9  13.6  14.1  14.5  14.8  15.4
61  3  154   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.4   5.4   7.4
61  3  155   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0   3.6   4.6   5.6   7.6
61  3  156   1  1  1   1X 11 12    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0   4.4   5.1   5.7   6.3   7.0   7.6
61  3  157   1  1  1   10 11 12    0 34  0  0  0 35  0  0  2  0     5.2   6.6   8.2   9.3   9.8  10.6  11.0  11.4  11.8  12.5
61  3  158   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.2   5.0   6.8
61  3  159   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0      .0   4.1   5.4   6.4   7.3   7.9   8.4   8.9   9.2   9.8
61  3  160   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0    .0    .0    .0    .0    .0    .0   4.3   5.3   7.3
```

61	3	161	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	4.3	5.9	7.1	8.1	9.0	9.4	9.9	10.4	10.7	11.4
61	3	162	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.8	4.6	6.3
61	3	163	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.0	5.1	6.0	7.0	7.6	8.4	9.0	9.8
61	3	164	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	.0	.0	.0	.0	[illegible].8	4.7	6.4
61	3	165	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.5
61	3	166	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.0	5.[illegible]	6.6	8.3
61	3	167	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.3
61	3	168	1	1	1	1X	1X	11	0	0	0	0	0	0	0	3	3	3	.0	.0	.0	.0	.0	.0	.0	4.3	4.8	6.0
61	3	169	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.[illegible]	4.6	5.6	6.6	8.6
61	3	170	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	.0	.0	.0	3.7	4.7	5.7	7.7
61	3	171	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.7	4.7	5.7	7.7
61	3	172	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.4	5.4	6.4	7.4	8.4	10.6
61	3	173	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.1	6.1	8.1
61	3	174	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.5	5.0	6.3
61	3	175	1	1	1	10	10	20	0	0	0	0	0	0	0	0	0	0	.0	3.6	5.0	6.7	8.0	9.1	10.0	11.0	11.9	13.2
61	3	176	1	1	1	20	21	22	0	0	0	0	0	0	0	0	0	0	17.9	18.7	19.[illegible]	20.7	21.5	22.1	22.9	23.2	24.0	24.6
61	3	177	1	1	1	20	21	21	0	0	0	0	0	0	0	0	0	0	15.3	16.3	17.3	18.2	18.[illegible]	19.6	20.1	20.7	21.3	22.2
61	3	178	1	1	1	22	22	23	3	3	3	3	3	3	31	3	3	3	17.2	17.7	17.9	18.6	18.9	19.3	19.6	20.1	20.6	20.8
61	3	179	1	1	1	20	21	21	14	14	14	14	14	14	14	14	14	14	14.6	14.9	15.8	16.[illegible]	17.2	17.7	18.3	18.9	19.6	20.6
61	3	180	1	1	1	22	24	24	3	3	3	3	3	3	3	3	3	3	14.3	14.5	14.8	15.0	15.3	15.4	15.4	15.4	15.6	15.6
61	3	181	1	1	1	20	21	21	0	0	0	0	0	0	0	0	0	0	12.6	13.4	14.3	15.2	15.8	16.5	16.9	17.7	18.2	19.2
61	3	182	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	52	6.8	7.4	8.2	9.0	9.3	9.6	9.9	10.4	10.9	11.5
61	3	183	1	1	1	22	21	22	0	0	0	0	0	0	0	0	0	52	11.6	12.1	12.7	13.2	13.5	14.0	14.4	15.0	15.3	16.1
61	3	184	1	1	1	34	24	2X	33	9	9	9	9	9	52	92	0	0	11.4	11.6	11.7	11.7	11.7	11.7	11.7	11.7	.0	.0
61	3	185	1	1	0	24	2X	44	0	0	0	0	0	35	91	0	0	0	12.1	12.3	12.4	12.4	12.4	12.4	12.4	.0	.0	.0
61	3	186	1	1	0	22	2X	44	14	14	2	52	92	0	0	0	0	0	22.4	22.7	23.1	23.5	23.5	.0	.0	.0	.0	.0
61	3	187	1	1	1	21	22	23	0	33	0	0	0	0	0	0	52	92	20.3	20.9	21.6	22.6	22.8	23.4	24.0	24.2	24.7	24.7
61	3	188	1	1	1	1X	1X	1X	0	0	95	0	0	0	0	0	0	0	5.7	5.7	5.7	.0	.0	.0	.0	.0	.0	.0
61	3	189	1	1	0	22	2X	44	0	0	0	0	92	0	0	0	0	0	23.2	23.9	24.7	25.2	25.2	.0	.0	.0	.0	.0
61	3	190	1	1	0	10	1X	44	0	0	0	0	0	0	91	0	0	0	8.1	9.1	11.3	12.9	14.5	15.5	15.5	.0	.0	.0
61	3	191	1	1	1	10	10	1X	0	0	0	0	0	0	0	0	0	0	.0	4.2	6.5	7.9	8.[illegible]	9.8	10.3	11.1	11.8	.0
61	3	192	2	2	0	44	44	44	0	64	2	52	62	0	0	90	0	0	31.3	31.4	31.4	31.4	31.5	31.5	31.5	31.5	.0	.0
61	3	193	1	1	0	1X	1X	44	0	0	0	0	0	92	0	0	0	0	.0	.0	.0	4.2	4.2	4.2	.0	.0	.0	.0
61	3	194	1	1	0	1X	1X	44	0	0	0	0	0	0	92	0	0	0	.0	.0	4.0	5.0	5.8	6.7	6.7	.0	.0	.0
61	3	195	0	1	1	44	11	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	4.6	5.2	5.7	6.3	7.0

TABLE 1..:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	4	1	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.0	6.0	8.0
61	4	2	1	1	1	10	10	10	0	0	0	0	0	0	0	0	0	0	.0	4.2	5.0	5.8	6.5	7.4	8.2	9.0	9.7	11.5
61	4	3	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.6	5.2	6.8
61	4	4	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.5	5.1	6.7
61	4	5	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.7	6.2
61	4	6	1	1	1	11	11	12	0	0	0	0	0	0	0	0	0	0	.0	4.3	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.8
61	4	7	1	1	1	12	11	21	0	0	0	0	0	0	0	0	5	5	8.5	9.0	9.5	10.0	10.4	10.9	11.4	11.9	12.5	13.4
61	4	8	1	1	1	20	20	21	0	0	0	0	0	0	0	0	5	0	12.8	13.6	14.4	15.2	16.0	16.8	17.4	18.2	18.8	20.2
61	4	9	1	1	1	11	20	20	0	0	0	0	0	0	0	0	5	0	10.7	11.2	11.7	12.2	12.7	13.7	14.7	15.7	16.7	18.8
61	4	10	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.1	5.1	6.1	7.1	8.1	8.7	9.5
61	4	11	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	3.8	4.5	5.2	6.0	6.7	7.3	7.8	8.1	8.9
61	4	12	1	1	1	10	11	11	0	0	0	0	0	0	0	0	5	0	5.0	5.8	6.5	7.3	8.0	8.5	9.0	9.5	11.0	11.5
61	4	13	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.6	6.2	7.5	8.4	9.5	10.1	11.3
61	4	14	1	1	1	1X	1X	10	0	0	0	0	0	0	0	14	14	14	.0	.0	.0	.0	.0	.0	3.7	4.7	5.7	7.7
61	4	15	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.4	5.4	7.4
61	4	16	1	1	1	1X	12	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.4	4.9	5.4	5.9	6.3	6.8	7.4	8.3
61	4	17	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.9	6.7
61	4	18	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.4	4.8	6.2
61	4	19	1	1	1	1X	1X	10	0	0	0	0	0	0	0	3	3	3	.0	.0	.0	.0	.0	.0	.0	4.3	5.3	7.3
61	4	20	1	1	1	10	21	22	0	0	0	0	0	0	5	0	0	0	7.5	8.8	10.1	10.9	11.9	12.8	13.1	13.7	14.2	14.8
61	4	21	1	1	1	10	21	22	0	0	0	0	0	0	5	0	0	0	6.5	[illegible]	10.5	11.9	12.4	13.2	13.7	14.3	14.7	15.3
61	4	22	1	1	1	10	12	12	0	0	0	0	0	0	5	0	0	0	4.6	5.9	7.2	8.4	9.1	9.5	10.1	10.2	10.6	11.1
61	4	23	1	1	1	10	12	12	0	0	0	0	0	0	5	0	0	0	4.0	5.0	6.4	7.6	8.9	8.9	9.4	9.9	10.5	11.2
61	4	24	1	1	1	1X	11	11	0	0	0	0	33	0	0	0	0	0	.0	.0	.0	4.1	4.5	5.0	5.5	6.5	7.0	8.0
61	4	25	1	1	1	10	10	12	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.7	5.9	6.7	7.5	8.4	9.0	9.6	10.4
61	4	26	1	1	1	1X	11	14	0	0	0	0	0	14	14	14	14	14	.0	.0	.0	3.8	5.4	6.6	6.8	7.0	7.2	7.4
61	4	27	1	1	1	11	12	12	0	0	0	0	0	0	0	0	5	0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	10.9	11.4	12.2
61	4	28	1	1	1	11	14	14	0	0	33	88	0	14	5	0	0	0	5.9	6.9	7.8	8.6	8.8	8.9	9.1	9.1	9.3	9.4
61	4	29	1	1	1	10	10	11	0	0	0	0	0	0	5	0	0	0	.0	3.8	5.2	6.5	7.4	8.2	8.9	9.6	10.2	11.3
61	4	30	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.0
61	4	31	1	1	1	10	11	22	0	0	0	0	0	0	5	0	0	0	4.6	5.2	7.8	9.2	10.1	10.8	11.3	11.9	12.5	13.1
61	4	32	1	1	1	1X	12	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.0	4.8	5.4	5.9	6.3	6.7	7.1	8.2
61	4	33	1	1	1	10	11	21	0	0	0	0	0	0	5	0	0	0	5.4	7.2	9.0	10.1	11.1	11.7	12.3	12.9	13.8	14.5
61	4	34	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	52	.0	.0	3.6	4.7	5.2	5.7	5.7	6.2	6.8	7.6
61	4	35	1	1	1	10	11	22	0	0	0	0	0	0	5	0	0	52	4.3	5.4	7.5	9.0	9.8	10.7	11.5	11.8	12.2	12.9
61	4	36	1	1	1	1X	12	13	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.4	4.9	5.3	5.7	6.1	6.4	6.9
61	4	37	1	1	1	11	11	12	0	0	0	0	0	0	0	0	0	0	5.0	5.8	6.6	7.2	7.8	8.3	8.8	9.3	9.8	10.5
61	4	38	1	1	1	1X	10	11	0	0	0	0	0	0	5	0	0	0	.0	.0	4.6	6.2	7.1	8.3	9.0	9.7	10.3	11.3
61	4	39	1	1	1	10	10	11	0	0	0	0	0	33	5	0	0	0	.0	3.6	4.6	5.6	6.6	7.6	8.4	9.1	9.8	10.8
61	4	40	1	1	1	1X	10	11	0	0	0	0	0	0	5	0	0	0	.0	.0	3.8	6.2	7.8	9.0	9.9	10.5	11.2	12.0
61	4	41	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	.0	4.4	5.1	5.6	6.6	7.0	7.4	7.8	8.4	8.8
61	4	42	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	11	.0	.0	.0	.0	.0	.0	.0	.0	4.3	6.0
61	4	43	1	1	1	10	11	12	0	0	0	0	0	0	5	0	0	0	.0	3.5	4.6	6.0	6.9	7.7	8.2	8.9	9.5	10.3
61	4	44	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.0
61	4	45	1	1	1	10	11	12	0	0	0	0	0	0	5	0	0	0	3.7	4.7	6.2	7.4	7.8	8.4	8.9	9.3	9.6	10.3
61	4	46	1	1	1	10	11	12	0	0	0	0	0	0	5	0	0	52	.0	3.7	4.9	6.1	6.9	7.5	8.1	8.8	9.3	10.1
61	4	47	1	1	1	10	12	14	0	0	0	0	0	0	5	0	0	0	.0	3.6	5.2	6.1	7.0	7.3	7.8	8.0	8.2	8.3
61	4	48	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.3	6.3
61	4	49	1	1	1	1X	1X	10	0	0	0	0	0	0	0	[illegible]	0	0	.0	.0	.0	.0	.0	.0	.0	3.8	4.8	6.8
61	4	50	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.0	4.7	5.6	6.5	7.4	8.3	9.0	9.7

```
61   4   51   1  1  1   1X 11 12    0  0  0  0  0  0  0  0  0  0     .0   .0  4.3  5.1  5.8  6.4  7.0  7.6  8.4  9.0
61   4   52   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0    4.6  5.0  5.4  5.8  6.2  6.6  7.0  7.4  7.8  8.2
61   4   53   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.9  4.9  5.9  7.9
61   4   54   1  1  1   10 12 11    0  0  0  0  0 14  5  0  0  0     .0  4.2  5.3  6.1  6.8  7.5  8.0  8.0  9.1 10.0
61   4   55   1  1  1   10 14 10    0  0 22  0  0  0  5  0  0 34    4.3  5.2  7.6  8.7  9.4  9.9 10.5  8.6 11.5 12.3
61   4   56   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0  4.9  6.8
61   4   57   2  2  2   44 44 44    0  0  0  0  0  0  0  0  0 52   27.7 27.8 28.0 28.0 28.1 28.2 28.3 28.4 28.4 28.4
61   4   58   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.1  5.1  6.1
61   4   59   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.3  5.1  5.8  7.4
61   4   60   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0   .0  8.0

61   4   61   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     .0  4.5  5.9  7.0  7.7  8.3  8.8  9.4 10.0 10.8
61   4   62   1  1  1   10 10 11    0  0  0  0  0  0  0  0  0  0    4.0  5.2  6.5  7.9  8.7  9.4 10.3 11.0 11.8 12.9
61   4   63   1  1  1   10 11 11    0  0  0  0  0  0  0  0  0  0    4.3  5.8  6.9  7.9  8.5  9.1  9.5 10.0 10.5 11.9
61   4   64   1  1  1   10 10 21    0  0  0  0  0  0  0  0  0  0    4.4  5.8  7.2  8.5  9.3 10.1 10.8 11.6 12.3 13.6
61   4   65   1  1  1   1X 12 12    0  0  0  0  0  0  0  0  0  0     .0   .0  4.3  5.2  5.7  6.2  6.6  7.0  7.4  7.9
61   4   66   1  3  3   20 22 22    0 20 20 20 20 20 20 20 20 20   13.4 14.2 15.4 16.7 17.3 17.7 18.2 18.7 19.2 19.7
61   4   67   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.2  4.9  6.2
61   4   68   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  4     .0   .0   .0   .0   .0   .0   .0  4.3  5.0  6.1
61   4   69   2  2  2   31 31 32    0  0  0  0  0  0  0  0  0  0   21.6 22.2 22.8 23.4 24.0 24.6 25.2 25.9 26.5 27.1
61   4   70   1  1  1   1X 10 12    0  0  0  0  0  0  0  0  5  3     .0   .0  4.4  5.2  6.0  6.8  7.4  8.1  9.1  9.5

61   4   71   1  1  1   10 10 11    0  0  0  0  0  0  0  0  5  0    3.6  4.6  5.6  6.6  7.6  8.6  9.6 10.5 11.4 12.3
61   4   72   1  1  1   23 22 24    0  0  0  0  0  0  0  0  0  3   14.3 14.5 14.7 14.9 15.1 15.8 16.2 16.4 16.6 16.7
61   4   73   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 33     .0   .0   .0   .0   .0   .0  4.1  5.2  6.2  8.2
61   4   74   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.4  5.4  6.4  8.4
61   4   75   1  1  1   10 10 11    0  0  0  0  0  0  0  0  0  0     .0  4.0  5.3  6.7  7.8  8.5  9.3 10.1 10.8 11.8
61   4   76   1  1  1   10 11 11    0  0  0  0  0  0  0  0  0  0    3.6  4.7  6.0  7.0  8.1  8.8  9.3 10.1 10.9 11.8
61   4   77   1  1  1   10 12 12    0  0  0  0  0  0  0  0  0  0    3.8  4.6  5.5  6.5  7.1  7.6  8.0  8.5  9.0  9.8
61   4   78   1  1  1   20 22 22    0  0  0  0  0  0 30  0  0  0   16.2 17.3 18.4 19.3 19.9 20.6 20.7 21.2 21.7 22.6
61   4   79   1  1  1   1X 1X 12    0  0  0  0  0  0  0  0  4  4     .0   .0   .0   .0   .0   .0  4.3  4.9  5.3  6.3
61   4   80   1  1  1   10 20 20    0  0  0  0  0  0  0  0  0  0    7.9  8.3  9.1 10.2 11.2 12.0 12.8 13.7 15.1 16.5

61   4   81   1  1  1   20 20 22    0  0  0  0  0  0  0  0  0  0   15.2 16.0 16.8 17.6 18.4 19.2 20.0 20.8 21.4 22.0
61   4   82   1  1  1   22 24 24    0  0  0  0  0  0  0  0  0  0   13.7 14.0 14.6 14.8 15.0 15.0 15.1 15.2 15.2 15.2
61   4   83   1  1  1   12 23 23    0  0  0  0  0  0  0  0  0  0   11.0 11.4 11.8 12.5 12.8 13.0 13.2 13.5 13.8 14.1
61   4   84   1  1  1   21 24 24    0 14  0  0  0  0  0  0  0 14   12.0 12.7 13.4 14.1 14.3 14.4 14.7 14.7 14.7 14.9
61   4   85   1  1  1   11 12 22    0  0  0  0  0  0  0  0  0  0    9.2  9.9 10.6 11.3 11.7 12.3 12.5 13.1 13.5 14.4
61   4   86   1  1  1   21 22 22    0  0  0  0  0  0  0  0  0  0   14.5 15.3 16.1 16.7 17.4 17.4 17.8 18.3 19.1 19.7
61   4   87   1  1  1   21 21 22    0  0  0  0  0  0  0  0  0  0   10.8 11.6 12.4 13.0 13.4 13.9 14.3 14.9 15.2 16.0
61   4   88   1  1  1   23 23 23    0  0  0  0  0  0 30  0  0 52   19.2 19.7 19.7 20.0 20.3 20.8 20.8 20.9 21.2 21.4
61   4   89   1  1  1   21 22 23    0  0  0  0  0  0  0  0  0  0   15.4 16.2 16.9 17.5 17.9 18.4 18.7 18.9 19.2 19.3
61   4   90   1  1  1   21 23 24    0  0  0  0  0  0  0  0  0  0   15.4 16.3 17.2 17.7 18.1 18.4 18.5 18.6 18.7 18.8

61   4   91   1  1  1   20 22 22    0  0  0  0  0  0  0 30 30  0   15.1 15.9 16.7 17.6 18.3 18.8 19.1 19.4 19.8 20.4
61   4   92   1  1  1   21 22 23    0  0  0  0  0  0 30  0  0  0   20.1 20.8 21.5 22.1 22.5 22.9 23.1 23.5 23.8 24.2
61   4   93   1  1  1   20 22 23    0  0  0  0  0  0  0  0  0  0   22.6 23.6 24.6 25.2 26.0 26.4 26.8 27.2 27.6 27.9
61   4   93   1  1  1   20 22 23    0  0  0  0  0  0  0  0  0  0   22.6 23.6 24.6 25.2 26.0 26.4 26.8 27.2 27.6 27.9
61   4   94   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.0  5.0  6.4
61   4   95   1  1  1   23 23 22   22 22 10 22 22 22 22 22 21 21   14.7 15.1 15.5 15.6 15.9 16.2 16.4 16.4 16.8 17.2
61   4   96   1  1  1   10 11 11    0  0  0  0  0  0  5  0  0  0    4.1  5.5  6.8  7.9  8.8  9.5 10.2 10.7 11.4 12.4
61   4   97   1  1  1   10 10 11    0  0  0  0  0  0  5  0  0  0     .0  3.5  4.5  5.8  6.7  7.5  8.1  8.8  9.6 10.3
61   4   98   1  1  1   1X 11 12    0  0  0  0  0  0  0  0  0  0     .0   .0   .0  4.3  5.4  6.1  6.1  7.0  7.6  8.3
61   4   99   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.0  4.4  4.9  6.3

61   4  100   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.3  4.8  5.2  6.6
61   4  101   1  1  1   10 10 11    0  0  0  0  0  0  0  0  0  0     .0  4.0  5.6  7.0  8.1  9.0  9.8 10.6 11.3 12.4
61   4  102   1  1  1   10 12 12    0  0  0  0  0  0  0  0  0 52    4.6  6.5  7.9  9.0  9.6 10.2 10.6 11.0 11.3 11.9
61   4  103   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.0  4.6  5.0  6.6
61   4  104   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.3  4.9  6.4
61   4  105   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.8  4.6  5.2  6.9
61   4  106   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.8  4.6  5.2  6.9
61   4  107   1  1  1   1X 12 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0  4.1  5.2  5.8  6.0  6.2  7.5  7.9
61   4  108   1  1  1   1X 12 12    0  0  0  0  0  0  0  0  0  0     .0   .0   .0  3.9  4.6  5.3  5.8  6.0  6.4  6.9
61   4  109   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0  4.3  5.5  6.5  7.3  8.0  8.7  9.6

61   4  110   1  1  1   13 13 13    0  0  0  0  0  0  0  0  0 74    4.6  4.9  5.3  5.4  5.6  5.8  6.1  6.4  6.7  7.0
61   4  111   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.3  5.3  6.3  8.3
61   4  112   2  2  2   44 44 44    0  0  2  0  0  0  0  0  0  0   27.8 27.8 27.8 27.8 27.8 27.8 27.8 27.8 27.8 27.8
61   4  113   1  1  1   21 22 23    0  0  0  0  0  0  0  0  0 52   18.7 19.3 20.0 20.5 21.0 21.4 21.7 21.9 22.1 22.5
61   4  114   1  1  1   22 22 22    0  0  0  0  0  0  0  0  0  0   15.4 16.0 16.6 16.9 17.3 17.6 18.0 18.1 18.4 19.0
61   4  115   1  1  1   21 22 22    0  0  0  0  0  0  0  0 30  0   17.6 18.2 18.8 19.5 20.2 20.5 21.1 21.4 21.9 22.7
61   4  116   1  1  1   22 22 23    0  0  0  0  0  0  0  0  0  0   19.6 20.0 20.4 20.8 21.2 21.8 21.8 22.0 22.2 22.6
61   4  117   1  1  1   23 23 23    0 74  0  0  0  0  0  0  0  0   13.3 13.4 13.5 13.7 14.0 14.1 14.2 14.5 14.7 15.0
61   4  118   1  1  1   11 12 12    0  0  0  0  0  0  0  0  0  0    7.9  8.2  8.8  9.3  9.8 10.2 10.5 10.9 11.2 12.0
61   4  119   1  1  1   22 22 23    0  0  0  0  0  0  0  0  0  0   14.0 14.3 14.5 15.3 15.7 16.0 16.3 16.6 16.8 17.1

61   4  120   1  1  1   21 22 22    0  0  0  0  0  0  0  0  0  0   19.4 20.0 20.6 21.1 22.0 22.5 22.9 23.1 23.4 24.2
61   4  121   1  1  1   22 22 24    0  0  0  0  0  0  0  0  0  0   16.7 17.1 17.6 18.0 18.4 18.9 19.1 19.2 19.4 19.5
61   4  122   1  1  1   23 23 24    0  0  0  0 31  0  0  0  0  0   14.8 15.1 15.3 15.6 15.8 16.1 16.2 16.4 16.6 16.6
61   4  123   1  1  1   22 22 22    0  0  0  0  0  0  0  0  0  0   13.1 13.4 13.7 14.1 14.5 14.9 15.3 15.8 16.1 16.6
61   4  124   1  1  1   21 21 22    0  0  0  0  0  0  0  0 30  0   12.9 13.6 14.3 15.0 15.6 16.2 16.7 17.2 17.6 18.4
61   4  125   1  1  1   10 10 11    0  0  0  0  0  0  0  0  0  0     .0  3.9  4.7  5.6  6.4  7.2  7.9  8.5  9.3 10.5
61   4  126   2  2  2   30 31 31    0 64  0  0  0  0  0  0  0  0   18.8 19.6 20.4 21.0 22.0 22.6 23.1 23.9 24.4 25.4
61   4  127   1  1  1   11 13 14    0  0  0  0  0  0  0  0  0  0    4.8  5.3  5.8  6.3  6.8  7.1  7.2  7.3  7.4  7.7
61   4  128   1  1  1   10 11 22    0  0  0  0  0  0  0  0  0  0    7.2  8.1  9.2  9.9 10.5 11.2 11.6 12.1 12.6 13.5
61   4  129   1  1  1   11 12 12    0  0  0  0  0  0  0  0  0  0    6.4  7.1  7.7  8.2  8.6  9.0  9.3  9.6  9.9 10.5

61   4  130   1  1  1   11 11 11    0  0  0  0  0  0  0  0  0  0    5.2  5.9  6.4  7.1  7.8  8.4  8.8  9.5  9.8 11.0
61   4  131   1  1  1   11 12 12    0  0  0  0  0  0  0  0  0  0    6.6  7.2  7.8  8.3  8.7  9.0  9.3  9.6  9.9 10.5
61   4  132   1  1  1   11 11 12    0  0  0  0  0  0  0  0  0  0     .0  4.3  5.0  5.5  6.0  6.8  7.4  8.0  8.5  9.0
61   4  133   1  1  1   11 12 12    0  0  0  0  0  0  0  0  0  0    7.4  8.1  8.9  9.6 10.1 10.5 10.7 11.0 11.3 11.8
61   4  134   1  1  1   11 21 22    0  0  0  0  0  0  0  0  0  0   10.2 10.8 11.4 12.2 12.9 13.4 13.8 14.4 15.0 15.8
61   4  135   1  1  1   10 12 23    0  0  0  0  0  0  0  0  0  0    8.0  8.9  9.8 10.8 11.2 11.7 12.1 12.5 12.8 13.2
61   4  136   1  1  1   1X 12 13    0  0  0  0  0  0  0  0  0  0     .0   .0   .0  4.0  4.7  5.1  5.4  5.7  6.0  6.3
61   4  137   1  1  1   11 12 11    0  0  0  0  0  0  0  0  0  0    4.3  5.0  5.6  6.1  6.5  6.9  7.3  7.7  8.3  9.2
61   4  138   1  1  1   11 12 12    0  0  0  0  0  0  0  0  0  0    4.4  4.9  5.4  6.0  6.4  6.8  7.2  7.6  8.0  8.8
61   4  139   1  1  1   21 23 23    0  0  0  0  0  0 30  0  0  0   24.0 24.8 25.4 26.2 26.6 26.8 27.1 27.4 27.5 27.9

61   4  140   1  1  1   10 12 22    0  0  0  0  0  0  0  0  0  0    7.8  8.9 10.0 10.8 11.4 12.0 12.4 12.8 13.3 13.8
61   4  141   1  1  1   10 12 21    0 14  0  0  0  0  0  0  0  0    7.6  8.4  9.2 10.0 10.7 11.1 11.4 11.7 12.0 13.7
61   4  142   1  1  1   20 20 21    0  0  0  0  0  0 30  0  0  0   10.8 11.8 13.4 14.7 15.6 16.6 17.1 17.9 18.4 19.4
61   4  143   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     .0  4.5  5.6  6.7  7.4  8.1  8.7  9.2  9.5 10.1
61   4  144   1  1  1   11 12 13    0  0  0  0  0  0  0  0  0  0    4.0  4.8  5.6  6.3  6.7  7.1  7.3  7.5  7.9  8.2
61   4  145   1  1  1   11 13 12    0  0  0  0  0  0  0  0  0  0     .0  3.6  4.4  4.7  5.4  5.6  5.8  6.0  6.4  7.1
61   4  146   1  1  1   10 11 12    0  0 74  0  0  0  0  0  0  0    4.0  4.9  6.0  7.0  7.6  8.4  9.0  9.6 10.1 10.9
61   4  147   1  1  1   11 12 12    0  0  0  0  0  0  0  0  0  0     .0  4.2  5.0  5.7  6.2  6.6  7.0  7.4  7.8  8.2
61   4  148   1  1  1   10 11 21    0  0  0  0  0  0  0  0  0  0    5.3  6.7  7.9  9.0  9.8 10.5 11.2 11.9 12.5 13.4
61   4  149   1  1  1   11 12 12    0  0  0  0  0 33  0  0  0  0     .0  4.1  4.7  5.4  6.0  6.5  6.8  7.2  7.6  8.0
```

```
61  4  150   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0  4.0  4.8  5.4  6.2  7.3  7.9  9.0
61  4  151   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.1  5.1  6.1  8.1
61  4  152   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.8  6.2
61  4  153   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.4
61  4  154   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.3  5.1  6.6
61  4  155   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  4.8  6.2
61  4  156   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  5.1  6.5
61  4  157   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.1  6.6
61  4  158   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.8  5.2  6.8
61  4  159   1  1  1   1X 10 10    0  0  0  0  0  0  0  0 43  0      .0   .0   .0  4.0  4.8  6.5  7.4  8.3  9.5 10.7

61  4  160   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0 14 14      .0   .0   .0   .0   .0   .0  3.5  4.5  5.5  7.5
61  4  161   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  5.4  7.0
61  4  162   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 14      .0   .0   .0   .0   .0   .0  4.0  4.8  5.8  7.4
61  4  163   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.1  4.8  5.5  7.0
61  4  164   2  2  2   42 42 43    0  0  0  0  0  0  0  0  0  0    29.6 30.2 30.6 31.0 31.4 31.8 32.2 32.6 33.0 33.4
61  4  165   2  2  2   44 44 44    0 14  0  0  0  0  0  0  0  0    24.9 25.1 25.3 25.5 25.5 25.6 25.6 25.6 25.7 25.7
61  4  166   2  2  2   32 32 33    0 66  0  0  0  0  0  0  0  0    25.7 26.2 26.7 27.0 27.4 27.7 28.0 28.4 28.5 28.8
61  4  167   2  2  2   42 42 42    0 54  0  0  0  0  0  0  0  0    25.3 25.8 26.3 26.5 26.9 27.2 27.4 27.7 28.0 28.8
61  4  168   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.2  7.2
61  4  169   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0   .0  4.2  5.0  5.8  6.6  7.4  8.2  9.0 10.9

61  4  170   2  2  2   42 43 43    0  9  5  0  0  0 20  0 20  0    28.6 29.2 29.7 30.1 30.5 30.9 31.0 31.1 31.4 31.8
61  4  171   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.6  5.4  6.2  7.0  7.9  9.0
61  4  172   1  1  1   1X 12 13    0  0  0  0  0  0  0  0  0  0      .0   .0  4.0  4.4  4.9  5.4  5.8  6.2  6.0  6.9
61  4  173   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0     5.5  5.8  6.1  6.4  6.7  7.0  7.4  7.7  8.0  8.9
61  4  174   1  1  1   1X 11 11    0  0  0  0  0  0  0  0  0  0      .0   .0  4.4  6.1  7.3  8.0  8.7  9.3 10.0 11.0
61  4  175   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0  3.7  5.3  6.6  7.5  8.0  8.8  9.5 10.4
61  4  176   1  1  1   1X 11 11    0  0  0  0  0 33  0  0  0  0      .0   .0  4.5  5.8  6.6  7.4  8.0  8.6  9.2 10.2
61  4  177   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 51      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.6
61  4  178   1  1  1   1X 11 12    0  0  0  0  0  0  0  0  0  0      .0   .0   .0  4.3  5.2  5.9  6.5  7.0  7.4  8.3
61  4  179   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.1  6.9

61  4  180   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 22      .0   .0   .0   .0   .0  4.1  4.6  5.0  5.6  7.1
61  4  181   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  4.9  6.5
61  4  182   1  1  1   12 11 12    0  0  0  0  0  0  0  0 20  0     4.3  4.8  5.2  5.6  6.0  6.5  7.0  7.6  8.0  8.9
61  4  183   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     4.0  4.9  5.9  6.6  7.5  8.1  8.7  9.2  9.8 10.4
61  4  184   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     4.6  5.6  6.9  8.0  8.6  9.2  9.7 10.3 10.7 11.7
61  4  185   1  1  1   11 12 13    0  0  0  0  0  0  0  0  0  0     4.2  5.0  5.7  6.4  6.8  7.4  7.7  8.1  8.4  8.9
61  4  186   1  1  1   11 12 12    0  0  0  0  0 14  0  0  0  0     7.2   .9  8.6  9.3  9.8 10.2 10.5 10.9 11.1 11.7
61  4  187   1  1  1   12 13 14    0  0  0  0  0  0  0  0  0  0     4.6  5.1  5.6  6.0  6.3  6.6  6.8  7.0  7.1  7.3
61  4  188   1  1  1   11 12 13    0  0  0  0  0  0  0  0  0  0     6.5  7.5  8.5  8.9  9.3  9.7  9.7 10.1 10.3 10.9
61  4  189   1  1  1   10 13 12    0 10  0  0  0  0  0  0  0 11     4.3  5.3  6.3  6.9  7.5  7.7  8.0  8.2  8.5  9.0

61  4  190   1  1  1   12 14 13    0  0  0  0  0  0  0  0  0  0     6.5  7.2  7.7  8.2  8.2  8.3  8.3  8.4  8.6  8.8
61  4  191   1  1  1   12 13 14    0  0  0  0  0  0  0  0  0  0      .0  4.2  4.6  5.0  5.2  5.4  5.6  5.8  6.0  6.2
61  4  192   1  1  1   12 12 13    0  0  0  0  0  0  0  0  0  0     5.7  6.2  6.7  7.1  7.4  7.7  8.0  8.3  8.6  9.0
61  4  193   1  1  1   11 12 13    0  0  0  0  0  0  0  0  0  0     5.8  6.3  6.9  7.6  8.0  8.3  8.4  8.8  9.2  9.5
61  4  194   1  1  1   10 22 22    0 20 14  0  0  3  0  0  0  0     9.3 10.1 11.0 11.9 12.4 12.8 13.2 13.7 14.3 15.0
61  4  195   1  1  1   12 12 13    0  0  0  0  0  0  0  0  0 14     4.5  5.0  5.7  6.1  6.4  6.7  7.0  7.2  7.4  7.8
61  4  196   1  1  1   10 11 22    0  0  0  0  0  0 30  0  0  0     7.8  8.7  9.7 10.6 11.2 11.7 12.2 12.8 13.3 14.2
61  4  197   1  1  1   10 11 21    0  0  0  0  0  0  0  0  0  0     8.3  9.3 10.3 11.4 12.1 12.7 13.4 13.9 14.5 15.8
61  4  198   1  1  1   10 11 11    0  0  0  0  0  0 30  0  0  0     6.0  7.0  8.5  9.5 10.2 10.9 11.4 12.1 12.6 13.6
61  4  199   1  1  1   1X 12 12    0  0  0  0  0  0  0  0  0  0      .0   .0  4.3  4.9  5.4  5.8  6.2  6.5  6.8  7.3

61  4  200   1  1  1   10 12 12    0  0  0  0  0  0  0  0  0  0      .0  3.7  4.6  5.4  6.1  6.5  7.0  7.4  8.0  8.7
61  4  201   1  1  1   12 12 14    0  0  0  0  0  0  0  0  0  0     5.4  6.1  6.8  7.3  7.5  7.8  7.9  8.4  8.5  8.7
61  4  202   1  1  1   10 10 11    0  0  0  0  0  0  0  0  0  0     4.9  6.4  7.8  8.8  9.6 10.3 11.0 11.8 12.8 13.9
61  4  203   1  1  1   10 11 11    0  0  0  0  0  0  0  0  0  0     8.1  9.1 10.2 11.2 11.7 12.3 12.7 13.3 13.9 14.9
61  4  204   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.9
61  4  205   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0 12 22      .0   .0   .0   .0   .0   .0  3.8  4.8  5.8  7.8
61  4  206   1  1  1   11 11 13    0  0 14  0  0  0  0  0  0  0     7.3  8.2  9.1  9.8 10.2 10.6 11.2 11.7 12.0 12.2
61  4  207   1  1  1   10 21 21    0  0  0  0  0  0  0  0  0 52     8.2  9.3 10.4 12.0 12.8 13.7 14.1 14.7 15.3 16.5
61  4  208   1  1  1   1X 11 11    0  0  0  0  0  0  0  0  0  0      .0   .0  3.9  4.5  5.1  5.7  6.2  6.8  7.4  8.3
61  4  209   1  1  1   1X 11 12    0  0  0  0  0  0  0  0  0  0      .0   .0   .0  4.3  4.9  5.5  6.0  6.6  7.0  7.6

61  4  210   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.3  5.0  6.7
61  4  211   1  1  1   10 12 12    0  0  0  0  0  0  0  0  0  0     4.5  5.5  7.0  8.1  8.7  9.1  9.5  9.8 10.2 10.8
61  4  212   1  1  1   10 10 11    0  0  0  0  0  0  0  0  0  0      .0  4.0  5.3  6.5  7.4  8.2  8.8  9.6 10.2 11.2
61  4  213   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  5.0  7.0
61  4  214   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0      .0  4.0  4.5  5.0  5.4  5.8  6.3  6.8  7.2  7.8
61  4  215   1  1  1   10 12 12    0  0  0  0  0  0  0  0  0  0      .0  4.8  5.7  6.7  7.3  7.7  8.2  8.7  9.0  9.8
61  4  216   1  1  1   11 12 14    0  0  0  0  0  0  0  0  0  0     4.5  5.3  6.1  6.9  7.1  7.5  7.7  8.0  8.1  8.2
61  4  217   1  1  1   1X 12 13    0  0  0  0  0  0  0  0  0  0      .0   .0  4.0  4.3  4.7  5.0  5.3  5.6  5.9  6.2
61  4  218   1  1  1   10 11 11    0  0  0  0  0  0  0  0  0  0     3.7  4.8  5.6  6.5  7.2  7.8  8.4  8.9  9.5 10.5
61  4  219   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0      .0  4.1  5.1  6.0  6.6  7.1  7.6  8.2  8.7  9.6

61  4  220   1  1  1   10 11 22    0  0  0  0  0  0  0  0  0  0     5.2  6.2  7.4  8.7  9.6 10.4 11.0 11.6 12.2 13.0
61  4  221   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0      .0  4.2  5.4  6.3  6.3  7.1  7.4  8.3  8.6  9.2
61  4  222   1  1  1   1X 12 13    0  0  0  0  0  0  0  0  0  0      .0   .0  4.0  4.3  4.7  5.2  5.6  5.8  6.1  6.5
61  4  223   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     5.8  6.6  8.0  9.0  9.8 10.5 10.9 11.5 11.9 12.7
61  4  224   1  1  1   10 11 22    0 33  0  0  0  0  0  0  0  0     6.9  8.0  9.4 10.6 11.5 12.1 12.5 13.2 13.7 14.4
61  4  225   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0     4.3  4.7  5.0  5.4  5.9  6.3  6.7  7.1  7.4  8.0
61  4  226   1  1  1   10 12 13    0  0  0  0  0  0  0  0  0  0     5.2  6.7  8.3  9.3  9.7 10.3 10.6 11.0 11.5 11.6
61  4  227   1  1  1   10 21 22    0 14  0  0  0  0  0  0  0  0     9.1 10.2 12.1 13.5 14.3 15.1 15.6 16.3 16.8 17.6
61  4  228   1  1  1   1X 11 12    0  0  0  0  0  0  0  0  0  0      .0   .0  4.0  4.6  5.2  5.8  6.4  7.0  7.6  8.2
61  .  229   1  1  1   10 12 23    0  0  0  0  0  0  0  0  0  0     6.8  7.7  9.0 10.0 10.5 10.9 11.3 11.7 11.8 12.1

61  4  230   1  1  1   10 21 22    0  0  0  0  0  0 10  0  0  0     8.6  9.6 11.1 12.4 13.1 13.7 14.2 14.9 15.5 16.2
61  4  231   1  1  1   10 11 21    0  0  0  0  0  0  5  0  0  0     6.3  7.0  8.3  9.7 10.6 11.4 12.0 12.7 13.3 14.4
61  4  232   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0      .0  4.2  5.5  6.5  7.3  7.9  8.4  8.9  9.4 10.2
61  4  233   1  1  1   1X 1X 10    0  0  0  0  0  0  0  3  3  3      .0   .0   .0   .0   .0   .0   .0  4.4  5.4  7.4
61  4  234   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     4.6  5.6  6.6  7.6  8.2  9.0  9.7 10.2 10.6 11.3
61  4  235   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0 43 33      .0   .0   .0   .0   .0   .0   .0  4.1  4.8  6.2
61  4  236   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.9  6.3
61  4  237   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.4  6.0
61  4  238   2  2  2   44 44 44    0  0  0  0  0  0  0  0  0  0    27.4 27.5 27.6 27.8 27.9 28.0 28.1 28.1 28.1 28.3
61  4  239   2  2  2   32 33 33    0  0  0  0  0  0  0  0  0  0    24.8 25.2 25.6 26.0 26.3 26.5 26.6 26.8 27.1 27.5

61  4  240   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 14      .0   .0   .0   .0   .0   .0  3.8  4.8  5.8  7.8
61  4  241   2  2  2   33 33 34    0  0  0  0  0 14 10  0  0  0    19.7 20.0 20.3 20.4 20.6 20.9 21.1 21.1 21.1 21.4
61  4  242   2  2  2   32 34 34    0  0  0  0  0  0 40  0  0  0    26.9 27.3 27.7 28.1 28.3 28.4 28.5 28.7 28.8 28.9
61  4  243   2  2  2   34 34 34   20 20  0 20  0 20 20 21 20 20    26.0 26.2 26.2 26.4 26.5 26.5 26.6 26.6 26.6 26.9
61  4  244   2  2  2   42 44 43   20 20 20 20  0 30  0  0 20 20    22.7 22.4 23.2 23.3 23.7 23.7 23.7 23.7 23.7 24.1
61  4  245   2  2  2   32 33 34    3  3 30  3  3  3 30 30 40 30    31.7 32.0 32.3 32.7 32.9 33.1 33.1 33.3 33.5 33.7
61  4  246   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.3  5.3  6.3  8.3
61  4  247   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.9  5.7  7.2
61  4  248   2  2  2   42 43 44    0  0  0  0  0  0  0  0  0  0    34.0 34.4 34.8 35.0 35.4 35.5 35.5 35.8 35.9 36.1
61  4  249   1  1  1   22 24 24    0  0  0  0  0  0  0 60  0 95    12.4 12.8 13.2 13.7 13.8 14.0 14.1 14.1 14.1 14.1
```

61	4	250	2	2	2	43	43	4X	20	64	21	21	0	0	20	60	90	0	28.5	28.7	28.7	29.0	29.3	29.5	29.6	29.8	29.8	.0
61	4	251	2	2	0	32	34	44	22	22	22	22	20	20	20	90	0	0	25.4	25.9	26.3	26.6	26.9	27.0	27.1	27.1	.0	.0
61	4	252	1	0	0	1X	44	44	0	0	14	95	0	0	0	0	0	0	.0	4.2	5.0	5.0	.0	.0	.0	.0	.0	.0
61	4	253	1	0	0	1X	44	44	20	20	95	0	0	0	0	0	0	0	5.8	6.0	6.0	.0	.0	.0	.0	.0	.0	.0
61	4	254	1	1	1	12	13	14	0	0	0	0	0	0	0	0	0	95	5.8	6.2	6.6	7.0	7.4	7.7	7.8	7.8	7.8	7.8
61	4	255	1	1	0	12	1X	44	20	20	20	0	0	0	95	0	0	0	5.0	5.5	6.0	6.3	6.4	6.3	6.3	.0	.0	.0
61	4	256	1	1	1	12	1X	1X	0	0	0	0	0	0	95	0	0	0	.0	4.2	4.8	5.0	5.5	5.8	5.8	.0	.0	.0
61	4	257	1	1	1	12	1X	1X	0	0	0	0	0	0	95	0	0	0	4.3	5.0	5.7	6.1	6.4	6.7	6.8	.0	.0	.0
61	4	258	1	1	0	13	1X	44	0	0	0	0	0	0	95	0	0	0	5.5	5.7	5.9	6.0	6.1	6.2	6.2	.0	.0	.0
61	4	259	1	1	1	12	14	14	30	30	30	30	30	30	32	32	32	98	9.8	10.0	10.2	10.7	10.9	11.1	11.1	11.1	11.1	11.1
61	4	260	1	1	1	10	10	13	0	0	0	0	0	0	0	0	32	98	7.6	8.0	8.6	9.8	11.1	12.2	13.0	13.8	14.2	14.3
61	4	261	2	2	2	42	43	4X	24	24	24	24	24	24	24	24	90	0	30.7	30.9	31.2	31.5	31.7	32.0	32.2	32.3	32.3	.0
61	4	262	2	2	2	42	42	44	0	0	0	0	40	40	41	41	43	93	30.2	30.7	31.2	31.7	31.8	32.4	32.5	32.7	32.7	32.8
61	4	263	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	99	6.5	6.6	6.8	7.0	7.2	7.3	7.5	7.7	8.4	8.4

TABLE 1.5:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	5	1	2	2	2	33	34	34	0	0	60	0	0	0	0	0	0	20	19.2	19.5	19.8	20.0	20.2	20.2	20.3	20.3	20.5	20.6
61	5	2	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	4.7	5.2	6.2
61	5	3	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	1	0	.0	.0	.0	4.0	4.5	5.0	5.5	6.1	6.7	7.7
61	5	4	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.9	4.5	5.0	6.4
61	5	5	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	4.7	5.2	6.5
61	5	6	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	4.4	5.6	7.1	8.3	9.2	10.2	11.1	12.6
61	5	7	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.5	5.0	6.7
61	5	8	2	2	2	34	34	34	24	64	52	0	0	0	0	0	0	0	30.1	30.3	30.4	30.4	30.5	30.5	30.5	30.5	30.5	30.5
61	5	9	2	2	2	32	33	33	0	0	0	0	0	0	30	0	0	0	26.0	26.8	27.3	28.0	28.1	28.4	28.5	28.7	29.1	29.3
61	5	10	1	1	1	10	11	22	0	0	0	0	0	0	30	0	0	0	7.3	8.0	9.1	9.9	10.3	11.0	11.5	12.0	12.3	13.3
61	5	11	1	1	1	20	20	22	0	0	0	0	0	0	30	0	30	0	20.4	22.4	23.9	25.1	26.1	27.0	27.5	28.3	28.9	29.7
61	5	12	1	1	1	21	22	22	0	0	0	0	0	14	0	0	30	0	13.0	13.6	14.1	14.7	15.3	15.4	15.8	16.2	16.6	17.2
61	5	13	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.0
61	5	14	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.0	5.8	7.2
61	5	15	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	.0	3.9	4.5	5.1	5.7	6.3	6.9	7.5	8.1	9.3
61	5	16	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.7	6.1
61	5	17	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	4.8	6.0	7.5
61	5	18	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.7
61	5	19	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.6	5.3	6.7
61	5	20	1	1	1	10	12	21	0	0	0	0	0	64	0	0	0	13	7.9	8.8	9.9	10.4	11.4	11.7	12.4	12.7	13.4	14.2
61	5	21	1	1	1	11	12	12	0	0	14	0	0	0	0	0	0	11	4.0	4.5	5.1	5.5	6.0	6.7	7.0	7.3	7.9	8.4
61	5	22	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.7
61	5	23	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.1	6.6
61	5	24	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.9	4.6	5.4	6.3	8.0
61	5	25	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.8	6.3
61	5	26	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.3	4.8	5.4	7.2
61	5	27	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.0
61	5	28	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	.0	.0	.0	4.3	5.5	7.2
61	5	29	1	1	1	1X	11	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.4	5.1	5.8	6.5	7.2	7.9	9.3
61	5	30	1	1	1	1X	11	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.3	5.0	5.8	6.0	6.7	8.2
61	5	31	1	1	1	1X	1X	10	0	0	0	0	0	0	0	30	30	33	.0	.0	.0	.0	.0	.0	4.2	4.7	5.3	7.0
61	5	32	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.0	5.8	6.6	8.6
61	5	33	2	2	2	42	43	44	0	0	0	0	0	0	0	0	0	0	32.1	32.4	32.8	33.2	33.4	33.8	34.0	34.1	34.1	34.4
61	5	34	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.0	6.0	8.0
61	5	35	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	0	4.8	5.9	7.9	8.3	9.1	9.9	10.5	11.2	11.7	12.6
61	5	36	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	0	5.7	6.9	8.2	9.5	10.4	11.1	11.7	12.5	13.1	14.4
61	5	37	1	1	1	1X	13	14	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.3	5.0	5.2	5.4	5.6	5.8	6.0
61	5	38	1	1	1	10	10	21	0	0	33	0	0	0	0	0	0	0	6.9	8.0	9.3	10.6	11.4	12.4	13.1	14.0	14.6	15.5
61	5	39	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.5	6.5
61	5	40	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.7	4.5	5.3	5.8	6.2	6.6	6.9	7.5
61	5	41	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.3	6.3
61	5	42	1	1	1	1X	12	13	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	3.6	4.2	4.7	4.9	5.1	5.3	5.7
61	5	43	1	1	1	1X	12	13	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.9	4.7	5.4	5.7	6.0	6.3	6.7
61	5	44	1	1	1	1X	12	13	0	0	0	0	0	0	0	0	0	0	.0	.0	3.8	4.5	5.4	6.0	6.3	6.6	6.9	7.3
61	5	45	1	1	1	1X	11	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.8	4.6	5.3	5.7	6.1	6.5	7.3
61	5	46	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.4	5.5	5.8	6.1	6.4	6.7	7.2
61	5	47	1	1	1	1X	13	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	5.1	6.0	6.2	6.4	6.6	6.9	7.5
61	5	48	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.7	4.4	4.8	5.2	5.6	6.0	6.6
61	5	49	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	34	5.2	6.5	8.1	9.7	10.5	11.2	12.0	12.3	12.8	13.3
61	5	50	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.6
61	5	51	1	1	1	10	10	22	0	0	0	0	0	0	30	0	0	0	7.0	7.8	9.3	9.7	10.3	12.0	12.6	13.4	13.9	14.8
61	5	52	1	1	1	10	12	23	0	14	0	0	0	0	0	0	0	35	6.6	7.6	9.0	10.0	10.6	11.2	11.5	11.9	12.2	12.5
61	5	53	1	1	1	10	21	22	0	0	0	0	0	0	0	0	0	3	8.7	9.7	10.8	12.0	12.6	13.2	13.6	14.1	14.6	15.4
61	5	54	1	1	1	11	13	13	0	0	0	0	0	0	0	0	0	0	4.8	6.3	7.0	7.7	7.8	8.2	8.3	8.5	8.7	9.1
61	5	55	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	0	5.0	5.7	6.5	7.3	7.7	8.2	8.4	8.8	9.2	9.5
61	5	56	1	1	1	12	12	13	0	0	0	0	0	0	0	0	0	0	5.6	6.0	6.4	6.8	7.2	7.6	8.0	8.4	8.6	8.8
61	5	57	1	1	1	11	12	12	0	0	0	0	0	0	33	9	0	34	5.5	5.6	5.8	7.0	7.6	8.0	8.4	8.7	9.2	9.6
61	5	58	1	1	1	1X	12	13	0	0	0	0	14	0	0	0	0	33	.0	.0	4.3	5.0	5.8	6.1	6.4	6.7	6.9	7.4
61	5	59	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	4.2	5.0	6.0	6.8	7.5	7.8	8.3	8.8	9.3	10.0
61	5	60	1	1	1	11	13	14	0	0	0	0	0	0	34	33	33	33	3.6	4.2	5.0	5.9	6.2	6.2	6.4	6.6	6.6	6.9
61	5	61	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	0	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.3
61	5	62	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.5	5.9	6.3	6.7	7.2	7.6	7.8	8.1	8.6	9.1
61	5	63	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	0	5.9	6.2	6.8	7.4	7.6	7.9	8.0	8.3	8.6	8.9
61	5	64	1	1	1	12	12	14	0	0	0	0	0	0	0	0	0	0	5.3	5.8	6.4	6.8	7.1	7.6	7.8	8.0	8.2	8.4
61	5	65	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	0	.0	4.2	4.8	5.2	5.5	5.7	5.9	6.0	6.3	6.6
61	5	66	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	0	6.6	7.5	8.9	9.8	10.3	10.9	11.5	11.8	12.3	12.6
61	5	67	1	1	1	12	14	14	0	0	0	0	0	0	0	0	0	0	6.1	6.6	7.2	7.8	8.0	8.0	8.0	8.2	8.3	8.5
61	5	68	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	5.7	6.4	7.3	8.2	8.5	9.1	9.4	9.8	10.2	10.8
61	5	69	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	4.2	5.0	5.9	6.8	7.4	8.0	8.3	8.8	9.2	9.8
61	5	70	1	1	1	1X	13	13	0	0	0	0	0	0	0	0	0	2	.0	.0	4.3	5.4	6.5	6.7	6.9	7.1	7.3	7.7

```
61   5   71   1 1 1   1X 1X 11   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.3  4.8  5.4  6.7
61   5   72   1 1 1   13 13 12   0  0  0  0  0  0  0  0  0  0    6.1  6.3  6.5  6.7  7.0  7.2  7.5  7.7  8.0  8.5
61   5   73   1 1 1   10 12 12   0  0  0  0  0  0 30  0  0  0     .0  3.7  5.3  7.0  7.5  8.1  8.4  8.9  9.3  9.9
61   5   74   1 1 1   10 12 13   0  0  0  0  0  0  0  0  0  0    3.7  4.5  5.5  6.4  6.9  7.4  7.6  7.9  8.2  8.6
61   5   75   1 1 1   10 12 12   0  0  0  0  0  0  0  0  0  0    4.4  5.2  6.4  7.1  7.6  8.0  8.4  8.8  9.1  9.7
61   5   76   1 1 1   10 12 12   0  0  0  0  0  0 30  0  0  0    6.1  7.0  8.3  9.0  9.8 10.2 10.5 11.1 11.5 12.1
61   5   77   1 1 1   1X 12 13   0  0  0  0  0  0  0  0  0  2     .0   .0   .0  4.4  5.0  5.4  5.7  6.0  6.3  6.7
61   5   78   2 2 2   34 34 34   0  9 52 65  0  0  0  0  0  0   23.4 23.5 23.7 23.8 23.9 23.9 23.9 23.9 23.9 23.9
61   5   79   1 1 1   1X 1X 11   0  0  0  0  0  0  0  0  0 14     .0   .0   .0   .0   .0  3.6  4.4  4.9  5.3  6.7
61   5   80   1 1 1   10 11 11   0  0  0  0  0  0  0  0  0  0    4.4  5.4  6.7  7.8  8.5  9.2  9.7 10.4 11.0 12.1

61   5   81   1 1 1   1X 12 13   0  0  0  0  0  2  2  2  2  2     .0   .0   .0  4.4  5.4  6.1  6.4  6.7  7.0  7.4
61   5   82   1 1 1   1X 1X 11   0  0  0  0  0  0  0 33 35  9     .0   .0   .0   .0   .0   .0  4.0  5.0  5.4  6.9
61   5   83   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.9  4.8  5.9  7.9
61   5   84   1 1 1   1X 11 11   0  0  0  0  0  0  0  0  0  0     .0   .0   .0  4.4  5.6  6.4  7.0  7.6  8.2  9.3
61   5   85   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.8  4.5  5.0  6.8
61   5   86   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.2  4.8  6.4
61   5   87   2 2 2   42 43 44   0 14 52 60 64  0  0  0  0  0   27.4 27.8 28.3 28.5 28.9 29.1 29.3 29.5 29.6 29.8
61   5   88   1 1 1   1X 10 10   0  0  0  0  0  0  0  0  0  0     .0   .0  3.9  5.5  6.5  7.5  8.4  9.2 10.1 11.4
61   5   89   1 1 1   1X 1X 1X   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0  4.1  6.1
61   5   90   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.2  5.0  5.8  7.1

61   5   91   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.2  5.0  5.9  7.1
61   5   92   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.9  4.7  5.3  6.8
61   5   93   1 1 1   20 21 21   0  0 30  0  0  0  0  0  0  0   13.1 14.1 15.2 16.3 17.1 17.9 18.4 19.0 19.6 20.8
61   5   94   1 1 1   12 24 24   0  0 30  9  0 33 33  0  0  0   10.9 11.2 11.5 11.8 12.0 12.1 12.1 12.2 12.2 12.2
61   5   95   1 1 1   10 12 21   0  0  0  0  0  0 30  0  0 21    8.7  9.5 10.1 11.0 12.0 12.1 12.7 13.3 13.8 14.8
61   5   96   1 1 1   21 21 22   0  0  0  0  0  0  0  0  0 41   17.5 18.0 18.6 19.0 19.5 20.0 20.6 21.0 21.3 21.8
61   5   97   1 1 1   21 22 22   0  0  0  0  0  0  0  0  0  0   19.7 20.8 21.9 22.4 22.9 23.3 23.8 24.3 24.7 25.5
61   5   98   1 1 1   20 22 22   0  0  0  0  0  0  0  0  0  0   17.0 17.8 18.6 19.4 20.2 20.8 21.1 21.5 21.8 22.9
61   5   99   1 1 1   13 13 13   0  0  0  0  0  0  0  0  0  4    4.4  4.5  4.6  4.8  5.1  5.3  5.6  5.8  6.0  6.5
61   5  100   1 1 1   21 22 22   0  0  0  0  0  0 30  0 30  0   21.2 21.7 22.3 22.9 23.2 23.8 24.1 24.5 24.9 25.6

61   5  101   1 1 1   24 24 24   0  0  0  0  0  0 30 30 30  0   16.6 16.7 16.9 16.9 16.9 17.0 17.0 17.1 17.1 17.1
61   5  102   1 1 1   22 22 23   0  0  0  0  0  0 30  0 30  0   17.6 18.0 18.5 19.0 19.2 19.6 19.8 20.2 20.4 20.9
61   5  103   1 1 1   21 21 21   0  3  0  0  0  0 30 30  0  0   20.7 21.4 22.1 22.8 23.4 24.1 24.6 25.1 25.6 26.9
61   5  104   2 2 2   43 44 44   0  0 52  0  0  0  0  0  0  0   32.8 33.0 33.1 33.4 33.5 33.8 33.8 33.9 33.9 34.0
61   5  105   1 1 1   1X 10 11   0  0  0  0  0  0  0  0  0  0     .0   .0   .0  4.4  5.2  6.0  6.7  7.4  8.1  9.4
61   5  106   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0 34  9     .0   .0   .0   .0   .0   .0   .0  4.2  4.8  6.3
61   5  107   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.0  4.6  6.1
61   5  108   1 1 1   12 12 13   0  0  0  0  0  0  0  0  0  0    8.2  8.6  9.0  9.4  9.7 10.0 10.4 10.8 10.9 11.3
61   5  109   1 1 1   21 22 23   0  0  0  0  0  0  0  0  0  0   21.5 22.1 22.8 23.3 23.8 24.2 24.4 24.7 24.8 25.2
61   5  110   1 1 1   12 12 13   0  0  0  0  0  0  0  0  0  0    7.2  7.5  7.9  8.1  8.5  8.8  9.0  9.3  9.6  9.8

61   5  111   1 1 1   13 14 14   0  0  0  0  0  0  0  0  0  0    9.4  9.6 10.0 10.2 10.3 10.5 10.5 10.6 10.6 10.8
61   5  112   1 1 1   22 23 23   0  0  0  0  0  0  0  0  0  0   14.3 14.6 14.8 15.0 15.5 15.8 15.5 16.2 16.5 16.7
61   5  113   1 1 1   20 22 21   0  0  0  0  0  0 30 30  0  0   18.7 19.3 20.1 20.7 21.5 22.0 22.3 22.7 23.2 24.2
61   5  114   2 2 2   43 44 43   0  0  0  0  0  0  0  0  0  0   29.2 29.4 29.7 30.0 30.1 30.3 30.5 30.5 30.7 31.0
61   5  115   2 2 2   43 43 44   0  0  0  0  0  0  0  0 30  0   27.0 27.2 27.4 27.6 27.7 28.0 28.0 28.1 28.1 28.5
61   5  116   2 2 2   43 44 42   0 64 52  0  0  0 30  0  0  0   26.1 26.3 26.5 26.8 27.0 27.3 27.3 27.3 27.8 28.1
61   5  117   2 2 2   42 44 44   0 64  0  0  0  0 30  0  0  0   31.0 31.4 31.8 32.1 32.5 32.6 32.6 32.7 32.9 33.0
61   5  118   1 1 1   1X 1X 11   0  0  0  0  0  0  0  0  0 14     .0   .0   .0   .0   .0   .0  4.2  4.9  5.3  6.7
61   5  119   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.1  5.0  5.8  7.3
61   5  120   1 1 1   1X 10 11   0  0  0  0  0  0  0  0  0  0     .0   .0  3.6  5.1  5.8  7.4  8.1  9.0  9.7 10.9

61   5  121   2 2 2   42 43 43   0 14  0  0  0  0 30  0  0  0   34.1 34.5 35.0 35.3 35.6 35.8 35.9 36.2 36.3 36.6
61   5  122   1 1 1   22 24 23   0  0  0  0  0  0 30 30  0  0   17.5 18.0 18.5 19.0 19.4 19.5 19.7 19.7 19.9 20.3
61   5  123   1 1 1   23 24 23   0  0  0  0  0 14 30  0  0  0   17.6 17.8 18.1 18.3 18.5 18.6 18.7 18.8 18.9 19.4
61   5  124   1 1 1   22 24 23   0  0  0  0  0  0 30  0  0  0   19.7 20.0 20.2 20.6 20.8 21.0 21.1 21.2 21.4 21.6
61   5  125   1 1 1   22 23 22   0  0  0  0  0  0  0  0  0  0   16.7 17.1 17.5 17.8 18.2 18.5 18.7 18.8 19.2 19.6
61   5  126   1 1 1   21 21 21   0  0  0  0  0  0  0  0  0  0   18.5 19.1 19.7 20.2 20.8 21.6 21.9 22.5 23.1 24.0
61   5  127   1 1 1   22 22 23   0  0  0  0  0  0  0  0  0  0   13.9 14.2 14.6 15.1 15.2 15.6 15.8 16.3 16.5 16.9
61   5  128   1 1 1   12 12 22   0  0  0  0  0  0  0  0  0  0    9.4  9.8 10.2 10.9 11.1 11.6 11.9 12.4 12.8 13.4
61   5  129   1 1 1   12 12 13   0  0  0  0  0  0  0  0  0  0    6.0  6.3  6.5  6.9  7.2  7.5  7.6  8.0  8.2  8.6
61   5  130   1 1 1   24 24 24   0 14  0  0  0  0  0  0  0  0   11.8 12.0 12.2 12.3 12.4 12.4 12.4 12.5 12.5 12.6

61   5  131   1 1 1   21 22 22   0  0  0  0  0  0 30  0  0  0   17.4 18.0 18.8 19.3 19.9 20.3 20.6 21.1 21.3 22.5
61   5  132   1 1 1   21 22 22   0  0  0  0  0  0  0  0  0  0   19.4 20.0 20.8 21.3 21.8 22.3 22.7 23.0 23.3 24.0
61   5  133   1 1 1   22 22 23   0 60  0  0  0  0  0  0  0  0   16.1 16.4 16.7 17.1 17.3 17.6 17.8 18.2 18.4 18.9
61   5  134   1 1 1   22 22 23   0 60  0  0  0  0  0  0  0  0   16.6 17.0 17.5 17.9 18.2 18.5 18.8 19.1 19.3 19.7
61   5  135   1 1 1   12 13 13   0  0  0  0  0  0  0  0  0  3    7.8  8.2  8.6  8.8  9.3  9.4  9.5  9.8 10.1 10.5
61   5  136   1 1 1   22 23 22   0  0  0  0  0  0  0  0 30  0   17.3 17.7 18.2 18.5 18.8 19.0 19.1 19.4 19.7 20.2
61   5  137   1 1 1   22 23 24   0  0  0  0  0  0  0  0  0  0   16.1 16.4 16.8 17.0 17.4 17.5 17.6 17.9 18.0 18.2
61   5  138   1 1 1   23 24 24   0  0  0  0  0  0  0  0  0  0   14.7 14.9 15.2 15.4 15.5 15.7 15.7 15.9 16.1 16.1
61   5  139   1 1 1   24 24 24   0  0  0  0  0  0  0  0  0  0   16.5 16.6 16.6 16.9 16.9 17.0 17.0 17.1 17.2 17.3
61   5  140   1 1 1   21 22 21   0  0  0  0  0  0  0  0  0  0   18.3 18.9 19.4 20.1 20.6 21.0 21.5 21.8 22.4 23.3

61   5  141   1 1 1   22 22 22   0  0  0  0  0  0 30  0  0  0   19.8 20.3 20.9 21.4 21.7 22.1 22.5 22.9 23.1 23.7
61   5  142   1 1 1   12 22 22   0  0 30  0 31  0 30  0 30  0   10.9 11.3 11.8 12.3 12.6 13.1 13.4 14.0 14.4 15.2
61   5  143   1 1 1   21 23 23   0  0 30  0 31 30 30  0  0  0   19.2 19.7 20.2 20.6 21.2 21.3 21.5 21.7 21.9 22.3
61   5  144   1 1 1   21 22 22   0  0  0  0  0  0 30  0  0  0   19.6 20.0 20.5 20.9 21.5 21.9 22.1 22.5 22.8 23.4
61   5  145   1 1 1   21 22 22   0  0  0  0  0 30 30  0  0  0   19.6 20.2 20.9 21.6 22.1 22.5 22.9 23.2 23.2 24.1
61   5  146   1 1 1   21 21 21   0  0 52  0  0  0 30  0  0  0   19.6 20.2 20.8 21.3 21.9 22.5 23.1 23.4 23.9 25.0
61   5  147   1 1 1   22 22 23   0  0  0  0  0  0 30  0 30  0   17.1 17.5 18.0 18.3 18.6 19.1 19.3 19.6 19.9 20.4
61   5  148   1 1 1   21 21 22   0  0  0  0  0  0 30  0  0  0   16.8 17.3 17.8 18.5 18.8 19.6 20.2 20.6 21.0 21.7
61   5  149   1 1 1   22 22 22   0  0  0  0  0  0 30  0  0  0   13.5 13.9 14.4 14.8 15.0 15.4 15.7 16.0 16.3 16.9
61   5  150   1 1 1   20 20 21   0  0  0  0  0  0 30  0  0  0   19.2 20.0 21.0 21.8 22.5 23.3 23.9 24.6 25.1 26.1

61   5  151   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.6  4.4  5.3  7.0
61   5  152   2 2 2   42 42 43   0  3  0  0  0  0 30  0  0  0   28.9 29.4 30.0 30.4 30.8 31.1 31.4 31.6 31.9 32.3
61   5  153   1 1 1   20 20 22   0  0  0  0  0  0  0  0  0  0   23.2 24.0 24.9 25.9 26.5 27.4 28.1 28.8 29.2 30.1
61   5  154   1 1 1   23 23 34   0  0  0  0  0  0 30  0  0  0   18.8 19.0 19.3 19.5 19.7 19.8 20.0 20.1 20.2 20.3
61   5  155   1 1 1   21 22 22   0  0 52  0  0  0 30  0  0  0   20.8 21.4 22.2 23.1 23.2 23.6 24.1 24.2 24.5 25.0
61   5  156   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.0  4.6  5.3  7.3
61   5  157   1 1 1   1X 1X 11   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.9  4.5  5.0  6.2
61   5  158   2 2 2   44 44 4X   0  0  0  0  3  0 81 91  0  0   28.2 28.4 28.7 28.7 28.7 28.8 28.8 28.9   .0   .0
61   5  159   1 1 1   1X 1X 1X   0  0  0 91  0  0  0  0  0  0    6.8  7.6  8.6  8.6   .0   .0   .0   .0   .0   .0
61   5  160   1 1 1   1X 1X 1X   0  0  0 91  0  0  0  0  0  0    5.0  5.7  6.4  6.4   .0   .0   .0   .0   .0   .0

61   5  161   2 2 2   4X 4X 4X   0  0 52 41  0  0  0  0  0  0   31.8 32.8 33.8 33.8   .0   .0   .0   .0   .0   .0
61   5  162   1 1 1   1X 1X 1X   0  0 99  0  0  0  0  0  0  0   19.9 19.9 19.9   .0   .0   .0   .0   .0   .0   .0
61   5  163   1 1 1   2X 2X 2X   0 65 52 92  0  0  0  0  0  0   21.3 21.5 21.7 21.7   .0   .0   .0   .0   .0   .0
61   5  164   1 1 1   2X 2X 2X   0 21  9 94  0  0  0  0  0  0   18.2 18.2 18.4 18.4   .0   .0   .0   .0   .0   .0
61   5  165   1 1 0   13 1X 44   0  0  0  0  0  0 95  0  0  0     .0  3.9  4.3  4.4  4.6  4.7  4.7   .0   .0   .0
61   5  166   1 1 0   11 1X 44   0  0  0  0  0  0 95  0  0  0    4.6  5.5  6.3  6.7  7.1  7.3  7.3   .0   .0   .0
```

TABLE 1.[illegible]

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	6	1	1	1	1	21	23	24	0	0	0	0	0	0	30	30	0	0	17.3	17.9	18.5	19.1	19.6	19.9	20.2	20.3	20.6	20.6
61	6	2	1	1	1	21	23	23	0	3	0	0	0	0	0	0	0	52	22.2	22.7	23.4	23.7	24.3	24.5	24.7	24.9	25.2	25.4
61	6	3	1	1	1	23	24	24	0	74	0	0	0	0	0	0	0	0	20.2	20.4	20.7	20.9	21.0	21.0	21.0	21.1	21.1	21.2
61	6	4	1	1	1	20	22	22	0	0	0	0	0	3	0	30	0	0	24.0	24.7	25.5	26.2	26.9	27.4	27.8	28.1	28.5	29.3
61	6	5	1	1	1	23	24	24	0	0	0	0	0	0	0	0	30	0	13.0	13.2	13.3	13.9	13.9	13.9	13.9	13.9	14.1	14.2
61	6	6	1	1	1	20	22	22	0	0	0	0	0	0	0	0	30	3	15.8	16.5	17.5	18.1	18.6	19.1	19.4	19.6	20.0	20.5
61	6	7	1	1	1	21	22	22	0	0	0	0	0	0	0	0	0	0	19.0	19.6	20.4	21.0	21.4	21.9	22.5	22.7	23.1	23.7
61	6	8	1	1	1	21	22	23	0	0	0	0	0	0	0	0	0	0	16.7	17.2	17.2	18.3	18.7	19.2	19.2	19.5	19.6	20.0
61	6	9	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	3.9	4.5	5.1	5.7	6.3	6.9	7.5	8.1	8.8	9.8
61	6	10	1	1	1	1X	11	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	5.0	5.5	6.0	6.4	7.4
61	6	11	1	1	1	10	11	21	0	0	0	0	0	0	0	0	0	0	6.7	7.9	8.4	10.6	11.4	12.1	12.7	13.3	13.8	14.9
61	6	12	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	6	13	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.5	5.0	5.7	6.2	7.6
61	6	14	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	14	14	.0	.0	.0	.0	.0	.0	.0	4.2	5.2	7.2
61	6	15	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.5	6.5
61	6	16	2	2	2	43	43	43	0	0	60	0	0	0	0	0	30	3	32.0	32.2	32.4	32.6	32.7	33.0	33.0	33.4	33.6	34.0
61	6	17	1	1	1	1X	11	10	0	0	0	0	0	0	0	0	14	14	.0	.0	.0	.0	3.6	4.3	4.7	5.3	6.1	7.5
61	6	18	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	4.7	5.2	6.9
61	6	19	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.9	4.9	5.9	6.9	7.9	9.9
61	6	20	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	4.0	4.6	5.4	5.9	6.6
61	6	21	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.0	5.7	7.1
61	6	22	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.7	4.5	5.3	5.9	7.4
61	6	23	1	1	1	1X	10	20	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	4.8	6.5	8.2	9.9	12.0	13.7	16.6
61	6	24	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.6	6.6
61	6	25	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.9	6.2
61	6	26	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.3	5.3	6.3	8.3
61	6	27	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	3.9	4.5	5.1	5.7	6.2	6.8	7.3	7.9	8.4	9.5
61	6	28	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.5	5.0	5.5	7.0
61	6	29	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.5	5.0	6.3
61	6	30	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.5	5.0	5.5	6.0	7.4
61	6	31	2	2	2	44	44	44	0	9	0	0	0	0	0	0	0	0	16.1	16.2	16.2	16.3	16.4	16.5	16.5	16.6	16.8	16.8
61	6	32	2	2	2	42	42	44	0	0	0	0	0	0	0	0	0	0	34.4	34.7	35.3	35.8	36.0	36.5	36.7	37.0	37.3	37.4
61	6	33	2	2	2	42	42	43	0	0	0	0	0	0	0	0	0	0	23.1	23.4	23.5	24.0	24.4	24.7	24.9	25.2	25.3	25.6
61	6	34	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.7	6.1
61	6	35	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.9	5.3	5.7	6.1	6.5	6.9	7.3	7.7	8.0	8.7
61	6	36	1	1	1	10	10	10	0	0	0	0	0	0	0	0	0	0	.0	3.5	4.4	5.2	6.0	6.9	7.7	8.5	9.9	11.0
61	6	37	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.0	6.0	8.0
61	6	38	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.9
61	6	39	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.6	6.0
61	6	40	1	1	1	21	22	23	0	0	52	0	0	0	0	0	0	0	22.8	23.4	24.0	24.5	25.1	25.6	25.8	26.0	26.5	26.7
61	6	41	1	1	2	22	22	34	0	0	0	0	0	0	31	31	0	0	25.3	25.8	26.4	27.0	27.2	27.5	27.7	28.0	28.0	28.0
61	6	42	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.9	4.9	6.9
61	6	43	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.6	6.6
61	6	44	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.7	4.8	5.4	6.0	6.4	6.8	7.2	7.8
61	6	45	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.8	6.1
61	6	46	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.9	4.9	6.9
61	6	47	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.7	4.6	5.2	5.7	6.2	6.6	7.0	7.8
61	6	48	1	1	1	1X	12	13	0	0	0	0	0	0	0	0	0	0	.0	.0	4.0	4.8	5.8	6.1	6.4	6.7	6.9	7.3
61	6	49	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.8	4.8	6.8
61	6	50	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.0
61	6	51	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.1	6.1	7.1
61	6	52	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.6	4.3	4.8	5.4	6.8
61	6	53	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.0	5.6	6.7
61	6	54	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	.0	.0	4.0	4.9	5.9	7.9
61	6	55	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.3	4.8	6.2
61	6	56	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.2	7.2
61	6	57	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.1	6.1	8.1
61	6	58	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.0
61	6	59	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.1	6.3
61	6	60	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.2	5.1	6.0	6.9	7.8	10.5
61	6	61	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.1	4.9	5.7	6.6	7.4	8.2	10.7
61	6	62	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.1	5.1	6.1	7.0	8.0	9.0	11.9
61	6	63	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.6	4.2	4.8	5.4	7.1
61	6	64	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	14	14	.0	.0	.0	.0	.0	.0	.0	3.8	4.7	6.7
61	6	65	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.7	4.4	6.0
61	6	66	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.5	6.5
61	6	67	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.4	6.4
61	6	68	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.3
61	6	69	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.7	4.3	4.8	5.4	6.9
61	6	70	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.3	5.0	6.5
61	6	71	1	1	1	21	21	21	0	3	0	0	0	0	30	0	0	0	18.4	19.1	19.9	20.6	21.1	21.7	22.2	23.0	23.7	25.0
61	6	72	1	1	1	21	20	21	0	0	0	0	0	3	0	0	30	52	16.7	16.8	17.6	18.3	18.9	19.6	20.2	21.1	21.8	23.0
61	6	73	1	1	1	23	23	23	0	0	0	0	0	14	0	0	0	0	12.4	12.6	13.0	13.2	13.3	13.6	13.7	13.9	14.2	14.3
61	6	74	1	1	1	21	22	22	0	3	0	0	0	0	0	0	0	0	14.9	15.5	16.2	16.6	17.2	17.6	17.8	18.0	18.4	18.8
61	6	75	1	1	1	21	22	23	0	0	0	0	0	0	0	0	30	0	19.0	19.6	20.1	20.9	21.5	21.9	22.3	22.6	22.9	23.4
61	6	76	1	1	1	22	22	23	0	0	0	0	0	0	0	0	0	52	15.9	16.4	17.0	17.4	17.8	18.2	18.4	18.7	18.9	19.4
61	6	77	1	1	1	10	11	12	0	33	0	0	0	2	0	0	0	0	6.8	7.4	8.2	9.1	9.5	10.1	10.5	11.1	11.7	12.3
61	6	78	1	1	1	20	21	23	0	0	0	0	0	0	0	0	0	0	20.8	21.6	22.6	23.4	24.1	24.8	25.3	25.8	25.9	26.4
61	6	79	1	1	1	20	21	22	0	0	0	0	0	0	0	0	0	0	19.3	20.1	20.9	21.7	22.4	23.0	23.5	24.3	24.5	25.6
61	6	80	2	2	2	32	34	33	0	9	0	0	0	0	0	0	0	0	25.1	25.6	26.1	26.5	27.0	27.1	27.3	27.4	27.6	27.9
61	6	81	2	2	2	33	34	34	0	0	0	0	0	14	0	0	0	0	15.3	15.6	15.8	16.0	16.4	16.4	16.5	16.7	16.7	16.8
61	6	82	2	2	2	33	33	33	0	65	0	0	0	9	0	0	0	0	13.4	13.6	13.8	14.1	14.3	14.5	14.6	14.8	15.0	15.3
61	6	83	2	2	2	32	32	33	0	0	0	0	0	3	0	0	0	0	22.9	23.2	23.5	23.9	24.2	24.6	24.8	25.1	25.6	25.9
61	6	84	2	2	2	32	32	33	0	0	0	0	0	0	0	0	0	52	34.6	34.9	35.3	35.6	35.8	36.3	36.4	36.8	37.1	37.4
61	6	85	2	2	2	32	33	34	0	0	0	0	0	0	0	0	0	52	19.0	19.3	19.6	19.9	20.1	20.3	20.4	20.6	20.7	20.9
61	6	86	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.0	5.7	6.4	8.7
61	6	87	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.0
61	6	88	2	2	2	43	44	43	0	0	0	0	0	0	0	0	0	3	23.7	23.9	24.0	24.2	24.5	24.7	24.7	24.8	25.0	25.3
61	6	89	2	2	2	43	44	43	0	9	0	0	64	0	0	0	0	0	21.4	21.6	21.9	22.1	22.3	22.3	22.5	22.6	22.8	23.2
61	6	90	2	2	2	32	33	33	0	64	0	0	0	14	0	0	0	0	16.0	16.3	16.5	16.9	17.1	17.2	17.4	17.7	17.9	18.2

```
61   6   91    1  1  1    1X 1X 1X     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0    .0   4.2   6.2
61   6   92    1  1  1    12 12 12     0  0  0  0  0  0  0  0  0  0      5.4   5.7   6.0   6.3   6.6   6.9   7.2   7.5   7.8   8.4
61   6   93    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   3.6   4.6   6.6
61   6   94    1  1  1    10 10 20     0  0  0  0  0  0  0 64  0  3      5.0   6.5   8.1   9.6  10.9  11.9  12.9  14.2  15.4  17.4
61   6   95    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.2   4.8   5.4   6.7
61   6   96    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   3.6   4.3   6.0   7.4
61   6   97    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.1   4.6   6.0
61   6   98    1  1  1    1X 10 11     0  0  0  0  0  0  0  0  0 14       .0    .0    .0   4.2   5.5   6.7   7.6   8.5   9.0  10.5
61   6   99    1  1  1    10 10 10     0  0  0  0  0  0  0  0  0  0       .0   3.6   5.1   7.5   9.5  11.2  12.5  14.1  15.6  18.7
61   6  100    1  1  1    10 10 10     0  0  0  0  0  0  0  0  0  3       .0   4.1   5.1   6.5   7.5   8.5   9.2  10.1  11.0  12.5

61   6  101    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   3.7   4.5   5.2   6.6
61   6  102    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0   4.2   5.0   5.7   6.4   7.9
61   6  103    1  1  1    1X 10 10     0  0  0  0  0  0  0  0  0  0       .0    .0   4.6   6.3   7.5   8.6   9.5  10.8  11.9  13.8
61   6  104    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.4   5.4   7.4
61   6  105    1  1  1    1X 10 12     0  0  0  0  0  0  0  0  0  0       .0    .0   3.6   4.4   5.9   7.3   7.8   8.4   8.8   9.4
61   6  106    1  1  1    10 10 20     0  0  0  0  0  0  0  0  0  3       .0   3.9   5.7   7.5   8.6   9.4  10.2  11.1  11.9  13.4
61   6  107    1  1  1    10 11 10     0  0  0  0  0  0  0  0  0  0       .0   4.2   5.3   6.6   7.4   8.4   8.9   9.2  10.2  11.5
61   6  108    1  1  1    10 11 12     0  0  0  0  0  0  0  0  0  0       .0   3.7   4.5   5.7   6.4   7.0   7.6   7.9   8.4   9.1
61   6  109    1  1  1    1X 13 12     0  0  0  0  0  0  0  0  0 33       .0    .0   4.2   5.4   5.4   5.5   5.5   5.9   6.3   6.7
61   6  110    1  1  1    12 12 13     0  0  0  0  0  0  0  0  0  0      4.6   4.9   5.2   5.5   5.7   6.0   6.3   6.5   6.7   7.0

61   6  111    1  1  1    10 10 11     0  0  0  0  0  0  0  0  0  3      3.8   4.8   5.9   7.0   7.8   8.6   9.3  10.1  10.2  11.9
61   6  112    1  1  1    10 11 12     0  0  0  0  0  0  0  0  0  3       .0   3.8   5.0   6.2   7.2   7.9   8.5   9.2   9.9  10.6
61   6  113    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.0   5.0   6.0   8.0
61   6  114    2  2  2    32 33 33     0 64 52  0  0  3  0  0  0  0     31.0  31.3  31.6  31.9  32.1  32.5  32.6  32.8  33.0  33.4
61   6  115    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.2   4.7   6.0
61   6  116    1  1  1    1X 1X 1X     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0    .0   4.1   6.1
61   6  117    1  1  1    10 11 12     0  0  0  0  0  0  0  0  0  0       .0   4.1   4.8   6.1   6.9   7.7   8.0   8.6   9.2  10.0
61   6  118    1  1  1    10 11 12     0  0  0  0  0  0  0  0  0  0       .0   4.1   5.0   6.4   7.2   7.7   8.2   8.7   9.2   9.9
61   6  119    1  1  1    10 11 11     0  0  0  0  0  0  0  0  0 52      4.4   5.5   6.6   7.8   8.7   9.4  10.0  10.6  11.2  12.4
61   6  120    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   3.8   4.8   6.8

61   6  121    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0   4.2   4.7   5.2   6.0   7.3
61   6  122    1  1  1    10 10 21     0  0  0  0  0  0  0  0  0  0       .0   4.6   6.4   8.0   9.3  10.4  11.2  12.3  13.1  14.4
61   6  123    1  1  1    12 12 12     0  0  0  0  0  0  0  0  0  0      5.1   5.4   5.8   6.1   6.5   6.8   7.2   7.5   7.9   8.6
61   6  124    1  1  1    1X 10 11     0  0  0  0  0  0  0  0  0  0       .0    .0   3.7   4.8   6.2   7.3   8.0   8.8   9.5  10.3
61   6  125    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  3       .0    .0    .0    .0    .0    .0    .0   3.6   4.6   6.6
61   6  126    1  1  1    1X 1X 1X     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0    .0   4.3   6.4
61   6  127    1  1  1    11 11 11     0  0  0  0  0  0  0  0  0  0       .0   4.1   4.6   5.1   5.6   6.1   6.6   7.1   7.6   8.6
61   6  128    1  1  1    11 11 11     0  0  0  0  0  0  0  0  0  0      4.1   4.7   5.3   5.9   6.5   7.1   7.7   8.3   8.9  10.1
61   6  129    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0    .0   4.3   5.6   7.6
61   6  130    1  1  1    22 22 23     0  0  0  0  0  0  0  0  0  0     18.0  18.5  19.0  19.5  19.9  20.6  20.9  21.3  21.6  22.0

61   6  131    1  1  1    11 22 22     0  0  0  0  0  0  0  0  0  0     10.2  10.6  11.3  12.1  12.7  13.1  13.5  14.0  14.4  15.0
61   6  132    1  1  1    22 22 23     0  0  0  0  0  0  0  0 30  0     16.9  17.4  17.9  18.4  18.8  19.3  19.5  19.7  20.0  20.4
61   6  133    1  1  1    22 22 22     0  0  0  0  0  0  0  0  0  0     16.8  17.3  17.7  18.4  18.7  19.1  19.3  19.8  20.2  20.7
61   6  134    1  1  1    24 22 22     0  0  0  0  0  0  0  0  0  0     17.4  17.5  17.6  17.8  17.8  17.8  18.0  18.6  19.0  20.0
61   6  135    1  1  1    12 12 11     0  0  0  0  0  0  0  0  0  4      7.9   8.3   8.5   8.8   9.5   9.9  10.4  10.9  11.3  12.4
61   6  136    1  1  1    22 22 21     0  0  0  0  0  0  0  0  0  0     15.5  15.8  15.9  16.4  16.6  16.9  17.3  17.9  18.4  19.5
61   6  137    1  1  1    24 23 22     0  3  0  0  0  0  0  0  0 32     13.0  13.1  13.2  13.4  13.5  13.5  13.7  14.1  14.5  15.1
61   6  138    1  1  1    21 21 21     0  0  0  0  0  0  0  0  0  0     17.1  17.7  18.2  18.9  19.4  19.9  20.3  20.9  21.4  22.5
61   6  139    1  1  1    21 22 22     0  0  0  0  0  0 30  0  0 30     17.1  17.6  18.1  18.7  19.1  19.9  19.9  20.1  20.6  21.0
61   6  140    1  1  1    12 13 12     0  0  0  0  0  0  0  0  0  4      6.1   6.4   6.6   6.8   7.2   7.3   7.5   7.8   8.2   8.6

61   6  141    1  1  1    21 22 22     0  0  0  0  0  0  0  0 30  0     14.4  15.0  15.5  16.3  16.8  17.2  17.5  17.8  18.1  18.6
61   6  142    1  1  1    22 23 22     0  0  0  0  0  0  0  0  0  3     12.6  13.0  13.3  13.6  14.2  14.5  14.7  14.9  15.2  15.7
61   6  143    1  1  1    13 14 13     0  0  0  0  0  9 33  0 33  4      5.5   5.7   5.9   6.1   6.3   6.5   6.5   6.5   6.8   7.1
61   6  144    1  1  1    21 21 22     0  0  0  0  0  0  0  0 30 31     22.1  22.8  23.6  24.3  24.8  25.6  26.0  26.4  26.8  27.3
61   6  145    1  1  1    21 22 22     0  0  0  0  0  0  0  0  0  3     18.2  18.9  19.6  20.2  20.9  21.2  21.7  22.0  22.4  23.2
61   6  146    1  1  1    22 23 23     0  0  9  0  0  0  0  0  0  0     14.0  14.4  14.7  15.5  15.6  15.7  15.8  16.1  16.4  16.9
61   6  147    1  1  1    23 24 24     0  0  0  0  0  0  0  0  0  3     21.1  21.3  21.6  21.9  22.0  22.1  22.2  22.2  22.2  22.5
61   6  148    1  1  1    21 22 22     0  0  0  0  0  0  0  0  0  3     11.8  12.3  12.8  13.5  13.9  14.3  14.5  14.9  15.4  16.1
61   6  149    1  1  1    1X 11 11     0  0  0  0  0  0  0  0  0  0       .0    .0   4.1   4.7   5.3   5.9   6.5   7.1   7.7   8.9
61   6  150    1  1  1    21 22 22     0  0  0  0  0  0 30  0  0  0     20.5  21.0  21.6  22.2  22.5  23.1  23.1  23.8  23.9  24.6

61   6  151    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  2       .0    .0    .0    .0    .0    .0    .0   3.9   4.7   6.7
61   6  152    1  1  1    1X 11 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0   4.2   4.7   5.3   6.0   6.7   8.1
61   6  153    1  1  1    21 22 20     0  0  0  0  0  0 30  0  0 14     17.0  17.5  17.9  18.6  19.0  19.4  19.8  20.1  22.1  24.1
61   6  154    1  1  1    22 22 23     0  0  0  0  0  0 30  0  0  0     17.7  18.1  18.6  19.0  19.3  19.8  19.9  20.2  20.5  20.9
61   6  155    1  1  1    21 22 22     0  0  0  0  0  0  0  0  0  0     16.7  17.3  17.9  18.5  19.0  19.4  19.8  20.2  20.6  21.0
61   6  156    1  1  2    24 24 34     0  0  4  0  0  0 30  0 30  0     13.6  13.8  14.0  14.1  14.2  14.2  14.3  14.3  14.3  14.5
61   6  157    1  1  1    22 22 22     0  0  0  0  0  0  0  0  0  0     20.2  20.6  21.0  21.6  21.8  22.3  22.6  22.8  23.1  23.6
61   6  158    1  1  1    21 21 22     0  0  0  0  0  0  0  0 30  0     21.6  22.3  23.2  23.8  24.4  25.1  25.4  25.9  26.5  27.1
61   6  159    1  1  1    21 22 22     0  0  0  0  0  0  0  0 30  0     17.8  18.5  19.2  19.9  20.5  21.0  21.4  21.8  22.2  23.0
61   6  160    1  1  1    21 22 34     0  0  0  0  0  0 30  0 30 30     23.2  23.9  24.6  25.2  25.9  26.4  26.8  27.1  27.3  27.5

61   6  161    2  2  2    32 32 32     0  0  0  0  0  0  0  0  0 41     20.1  20.6  21.0  21.6  22.0  22.5  22.9  23.3  23.7  24.4
61   6  162    1  1  1    22 24 34     0  3  9  0 32  0 30  0  0  0     18.7  19.0  19.4  19.7  20.0  20.2  20.3  20.4  20.5  20.6
61   6  163    1  1  1    22 23 23     0  0  0  0  0  3  0  0  0  0     17.0  17.4  17.8  18.3  18.6  18.9  19.1  19.2  19.4  19.6
61   6  164    1  1  1    21 22 22     0  0  0  0  0  0  0  0  0  0     21.1  21.7  22.3  23.0  23.6  24.2  24.5  25.0  25.4  25.9
61   6  165    1  1  1    22 24 24     0  0  0  0  0  0 30  0  0  0     16.6  17.0  17.6  17.8  18.1  18.2  18.4  18.4  18.5  18.6
61   6  166    1  1  1    21 23 23     0  3  0  0  0  0  0  0  0 52     16.0  16.6  17.4  18.0  18.5  18.7  19.0  19.2  19.5  19.9
61   6  167    1  1  1    23 24 23     0 65  0  0  0  0 30  0  0  0     12.4  12.6  12.8  12.9  13.1  13.1  13.3  13.4  13.6  13.8
61   6  168    1  1  1    21 22 22     0  0  0  0  0  0 30  0  0  3     17.5  18.1  18.8  19.3  19.8  20.2  20.5  20.8  21.1  21.6
61   6  169    1  1  1    22 22 22     0  0  0  0  0  0  0  0 30  0     14.3  14.8  15.3  15.9  16.2  16.4  16.7  17.2  17.7  18.3
61   6  170    1  1  1    20 22 22     0  0  0  0  0  0 30  0 30 30     12.4  13.1  13.9  14.7  15.3  15.8  16.2  16.5  16.9  17.6

61   6  171    1  1  1    21 22 22     0  0  0  0  0  0 30  0 30 52     18.6  19.3  19.8  20.4  21.2  21.5  22.0  22.4  23.0  23.7
61   6  172    1  1  1    20 21 22     0  0  0  0  0  0 30  0 30 52     18.8  19.6  20.4  21.2  21.9  22.6  23.2  23.9  24.4  25.3
61   6  173    1  1  1    1X 10 11     0  0  0  0  0 33  0  0  0  0       .0    .0    .0   4.8   6.2   7.2   7.7   8.5   9.3  10.5
61   6  174    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   4.2   5.0   5.9   7.2
61   6  175    1  1  1    1X 1X 1X     0  0  0  0  0  0 92  0  0  0       .0    .0    .0    .0   5.8   6.9   7.1    .0    .0    .0
61   6  176    2  2  2    43 44 44     0 64 52  0  0  0 31  0  0  0     35.8  36.1  36.4  36.7  36.9  37.0  37.0  37.0  37.1  37.2
61   6  177    1  1  1    11 10 11     0  0  0  0  0  0  0  0  0  0       .0   4.1   4.8   5.5   6.2   6.9   7.6   8.3   9.0  10.4
61   6  178    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0 33       .0    .0    .0    .0    .0    .0    .0   4.3   5.0   6.5
61   6  179    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0    .0    .0    .0    .0    .0   3.8   4.5   5.2   6.8
61   6  180    1  1  1    1X 1X 1X     0  0  0 95  0  0  0  0  0  0      8.2   8.2   8.4   8.4    .0    .0    .0    .0    .0    .0

61   6  181    2  2  2    4X 4X 4X     0 64 91  0  0  0  0  0  0  0     29.2  29.2  29.2    .0    .0    .0    .0    .0    .0    .0
61   6  182    2  2  2    34 34 34     0  0  0  0  0  0  0  0  0 92     27.3  27.5  27.8  27.9  27.9  27.9  27.9  27.9  27.9  27.9
61   6  183    2  2  2    34 3X 3X     0 65 52  0 90  0  0  0  0  0     31.5  31.6  31.6  31.7  31.7    .0    .0    .0    .0    .0
61   6  184    2  2  2    44 4X 4X     0 65 60  0 52 90  0  0  0  0     37.3  37.5  37.8  37.8  37.9  37.9    .0    .0    .0    .0
61   6  185    2  2  2    43 4X 4X     0 66  0 52 92  0  0  0  0  0     23.8  24.1  24.5  24.6  24.6    .0    .0    .0    .0    .0
61   6  186    1  1  1    20 2X 2X     0  0  0  0  0  0 97  0  0  0     15.8  16.8  17.8  18.9  19.8  20.8  20.8    .0    .0    .0
```

TABLE 1.7:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	7	1	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.3	6.4	7.8
61	7	2	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	5.1	5.8	6.5	7.2	7.8	8.3	9.5
61	7	3	1	1	1	10	11	13	0	0	0	0	0	0	33	0	0	0	3.6	4.0	4.6	5.3	6.1	6.9	7.6	8.2	8.6	8.9
61	7	4	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	3.9	4.6	5.7	6.2	7.0	7.6	8.0	8.5	9.3
61	7	5	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.0	6.0	6.6
61	7	6	1	1	1	10	11	10	0	33	0	0	0	0	0	0	0	0	4.1	5.2	5.7	7.7	8.5	9.2	9.8	10.4	11.2	13.7
61	7	7	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.9	5.3	5.7	6.1	6.5	6.9	7.3	7.7	8.2	8.9
61	7	8	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.0	5.6	6.2
61	7	9	1	1	1	1X	12	11	0	0	0	0	0	0	0	0	11	11	.0	.0	3.6	4.5	5.1	5.7	5.9	6.2	6.7	7.9
61	7	10	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.4	5.4	6.4
61	7	11	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	5.0	5.9	6.5	7.0
61	7	12	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.5	4.9	6.9
61	7	13	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	35	9	.0	.0	.0	.0	.0	.0	.0	.0	4.1	6.1
61	7	14	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.3	6.3
61	7	15	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.1	7.1
61	7	16	1	1	1	10	10	20	0	0	0	0	0	0	0	0	0	0	.0	3.6	5.2	7.3	8.8	9.9	10.8	11.7	12.5	13.8
61	7	17	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.3	6.3
61	7	18	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	7	19	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	.0	.0	4.0	5.0	6.0	8.0
61	7	20	2	2	2	31	32	32	0	0	0	0	0	0	0	0	0	0	19.4	20.0	20.5	21.3	21.8	22.4	22.6	22.9	23.3	23.9
61	7	21	2	2	2	43	42	43	0	0	42	0	0	0	31	0	0	0	31.9	32.1	32.1	32.6	32.8	33.2	33.5	33.7	34.0	34.4
61	7	22	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.5	6.5
61	7	23	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	3.6	4.5	5.5	7.5
61	7	24	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.0
61	7	25	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.9	4.9	6.9
61	7	26	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.2	7.2
61	7	27	2	2	2	42	44	43	30	30	30	30	62	30	30	30	30	30	25.0	25.4	25.9	26.3	26.6	26.8	26.8	26.9	27.1	27.5
61	7	28	2	2	2	42	43	43	30	64	30	30	60	30	30	30	30	30	28.4	28.7	29.1	29.5	29.7	30.0	30.1	30.3	30.5	31.0
61	7	29	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.2
61	7	30	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	7	31	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.8
61	7	32	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.8
61	7	33	1	1	1	20	22	23	0	0	0	0	0	0	0	0	0	0	17.5	18.2	19.2	19.8	20.4	20.9	21.2	21.7	21.9	22.4
61	7	34	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.4	6.4
61	7	35	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.5	6.5
61	7	36	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	9	9	.0	.0	.0	.0	.0	.0	.0	4.0	4.2	6.2
61	7	37	1	1	1	10	12	14	0	0	0	0	0	0	33	33	35	9	4.8	5.8	7.2	8.1	8.8	9.4	9.6	10.0	10.0	10.3
61	7	38	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	4.8	5.5	6.6	7.2	7.7	8.2	8.6	9.1	9.4	10.2
61	7	39	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	52	4.0	4.9	6.1	7.0	7.7	8.0	8.3	8.7	9.2	9.8
61	7	40	1	1	1	10	12	12	0	0	0	0	0	0	33	33	0	0	5.1	6.4	8.0	9.5	10.2	10.6	11.1	11.5	11.9	12.5
61	7	41	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.0	6.0	8.0
61	7	42	1	1	1	1X	14	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.1	4.3	4.6	4.6	4.7	4.8	6.0
61	7	43	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.8
61	7	44	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.9
61	7	45	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	5.0	6.0	7.0	9.0
61	7	46	1	1	5	1X	1X	14	0	0	0	0	0	4	5	11	7	0	.0	.0	.0	.0	.0	.0	.0	10.0	10.0	10.0
61	7	47	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.1	6.1	8.1
61	7	48	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.5	6.5	8.5
61	7	49	2	2	2	42	43	43	30	60	52	30	30	30	30	0	30	30	24.6	24.9	25.3	25.6	25.7	26.0	26.1	26.2	26.4	26.6
61	7	50	2	2	2	34	34	3X	0	64	52	0	0	0	30	90	0	0	22.6	22.7	22.9	22.9	22.9	22.9	22.9	22.9	.0	.0
61	7	51	2	2	2	33	34	34	30	31	31	31	30	64	30	30	30	32	23.2	23.4	23.8	24.0	24.1	24.3	24.4	24.5	24.7	24.7
61	7	52	2	2	2	42	43	43	32	32	32	32	32	32	32	32	31	31	26.0	26.3	26.8	27.0	27.3	27.5	27.7	27.9	28.0	28.3
61	7	53	2	2	2	32	33	32	30	14	31	31	31	32	31	31	30	0	18.3	18.7	19.1	19.4	19.8	20.2	20.3	20.5	20.9	21.5
61	7	54	2	2	2	43	44	44	31	9	32	32	31	31	31	31	32	98	22.9	23.1	23.3	23.5	23.6	23.6	23.6	23.6	23.6	23.6
61	7	55	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	4.9	5.5	6.1	6.7	7.3	7.9	9.1
61	7	56	1	1	1	1X	1X	10	0	0	0	0	0	0	30	33	33	33	.0	.0	.0	.0	.0	.0	4.0	4.5	4.9	6.9
61	7	57	2	2	2	43	44	44	0	52	60	0	0	0	0	0	0	0	30.1	30.3	30.5	30.7	30.9	31.0	31.0	31.1	31.3	31.4
61	7	58	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.7	5.2	5.9	6.7	6.7	8.4	9.2	10.2
61	7	59	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.5	4.9	5.3	5.7	6.1	6.5	6.9	7.3	7.7	8.5
61	7	60	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.0	5.3	6.2	7.1	7.9	8.4	8.8	9.8
61	7	61	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	0	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.4
61	7	62	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.3	5.3	6.3	8.3
61	7	63	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.2	7.2
61	7	64	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.8
61	7	65	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	3	3.6	4.4	5.5	6.5	7.3	8.1	8.9	9.4	10.1	11.2
61	7	66	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.8
61	7	67	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.1	6.1	8.1
61	7	68	1	1	1	11	11	12	0	33	0	0	0	0	0	0	0	0	4.6	5.3	6.1	6.7	7.4	8.1	8.7	9.2	9.6	10.2
61	7	69	1	1	1	10	12	12	0	9	33	0	0	0	0	0	0	0	5.9	6.9	8.0	8.8	9.8	10.1	10.6	10.7	11.3	11.5
61	7	70	1	1	1	1X	12	10	0	0	0	0	0	0	0	0	0	0	.0	.0	3.8	4.7	5.3	5.8	6.2	8.6	11.3	11.5
61	7	71	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	.0	4.1	4.6	5.4	5.9	6.3	6.7	7.1	7.4	8.0
61	7	72	1	1	1	1X	1X	11	0	0	0	0	0	0	0	33	33	34	.0	.0	.0	.0	.0	.0	4.0	5.5	6.5	7.5
61	7	73	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	3	6.7	7.7	9.1	10.1	10.6	11.5	12.0	12.8	13.5	14.3
61	7	74	1	1	1	10	11	21	0	0	0	0	0	0	0	0	0	0	7.0	8.1	9.5	10.7	11.3	12.1	12.6	13.4	14.2	15.0
61	7	75	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	4.0	4.9	6.1	7.0	7.7	8.4	9.0	9.7	10.3	11.2
61	7	76	1	1	1	1X	1X	10	0	0	0	0	0	0	0	33	33	34	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.6
61	7	77	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.7	5.7	6.4	7.1	7.8	8.4	9.2
61	7	78	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	.0	4.0	5.2	6.4	7.3	7.9	8.6	9.3	10.0	11.2
61	7	79	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.4	6.4
61	7	80	1	1	1	10	10	12	0	0	0	0	0	0	0	0	0	0	.0	3.9	4.8	5.9	6.7	7.5	8.0	8.7	9.4	10.0
61	7	81	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.8	5.8	7.8
61	7	82	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.7	6.7
61	7	83	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.8	6.8
61	7	84	2	2	2	33	34	34	0	0	42	0	0	0	62	0	0	0	31.1	31.3	31.6	31.8	31.9	31.9	31.9	32.0	32.1	32.2
61	7	85	1	1	1	10	20	21	0	33	0	0	0	0	0	0	0	3	9.1	10.0	10.9	11.8	12.6	13.4	14.0	14.8	15.6	16.6
61	7	86	1	1	1	11	12	12	0	35	11	0	0	0	0	0	0	0	5.3	6.0	7.0	7.4	8.0	8.2	8.4	8.8	9.1	9.8
61	7	87	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.3	6.3	8.3
61	7	88	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.5	5.6	7.6
61	7	89	1	1	1	1X	13	12	0	0	0	0	0	0	0	0	3	3	.0	.0	3.7	4.1	4.4	4.8	4.8	5.0	5.3	6.3
61	7	90	1	1	1	11	12	13	0	33	2	0	0	11	0	0	0	0	5.0	5.5	6.2	6.7	7.2	7.6	7.9	8.3	8.5	8.9

61	7	91	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	3	7.3	8.1	9.2	9.8	10.5	10.9	11.5	12.1	12.8	13.5
61	7	92	1	1	1	11	10	14	0	0	0	0	0	0	0	0	0	14	4.9	5.5	6.1	6.7	7.3	7.7	7.9	12.1	8.8	9.4
61	7	93	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	9	4.8	5.4	6.1	6.7	7.3	7.7	8.1	8.5	8.7	9.1
61	7	94	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	0	5.8	6.3	7.0	7.4	7.8	8.1	8.3	8.7	9.0	9.3
61	7	95	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	0	7.7	8.1	8.5	8.9	9.2	9.4	9.7	9.9	10.2	10.6
61	7	96	1	1	1	12	12	12	0	33	0	0	0	0	0	0	0	14	6.4	6.7	7.1	7.5	7.7	8.0	8.2	8.6	8.9	9.6
61	7	97	1	1	1	11	12	13	0	52	0	0	0	0	0	0	0	[illegible]	7.1	7.7	8.6	9.1	9.5	10.1	10.2	10.6	11.0	11.1
61	7	98	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	5.1	6.1	7.3	8.1	9.0	9.5	10.0	10.7	11.3	12.1
61	7	99	1	1	1	11	13	13	0	0	0	0	0	14	14	14	14	52	3.6	4.4	5.2	5.7	6.2	6.6	6.8	6.9	7.1	7.4
61	7	100	1	1	1	10	12	13	0	0	0	0	0	0	0	0	0	0	4.7	5.4	6.3	7.0	7.5	7.9	8.1	8.4	8.7	9.0
61	7	101	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	4.4	5.0	5.6	6.0	7.0	7.3	7.6	7.9	8.2	8.8
61	7	102	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	4.0	4.8	5.5	6.2	6.6	7.0	7.4	7.8	8.0	8.6
61	7	103	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.1
61	7	104	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.1
61	7	105	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	3.7	4.5	5.4	6.2	6.9	7.5	8.0	8.6	9.1	10.0
61	7	106	2	2	2	34	34	34	0	0	2	0	0	0	0	0	0	0	36.0	36.1	36.3	36.4	36.4	36.4	36.4	36.4	36.4	36.4
61	7	107	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	5.0	5.6	6.2	7.0	7.5	7.8	8.1	8.6	9.1	9.5
61	7	108	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	0	6.3	6.8	7.4	7.8	8.4	8.6	8.9	9.3	9.5	9.9
61	7	109	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	6.1	6.8	7.8	8.4	9.0	9.3	9.7	10.1	10.5	11.0
61	7	110	1	1	1	10	10	22	0	0	0	0	0	0	0	0	0	0	5.1	6.1	7.4	8.1	9.0	9.6	10.6	11.3	11.6	12.2
61	7	111	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	4.2	5.5	6.2	7.0	7.6	8.1	8.5	8.9	9.8
61	7	112	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.8	5.8	7.8
61	7	113	1	1	1	12	14	12	0	0	0	0	0	0	0	0	0	14	.0	4.0	4.5	5.0	5.3	5.4	5.4	5.6	5.8	6.6
61	7	114	1	1	1	11	13	14	0	0	34	0	0	0	0	0	0	0	.0	3.6	4.2	4.8	5.2	5.5	5.6	5.8	5.9	6.1
61	7	115	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	20	4.7	5.8	7.2	8.3	9.1	9.6	10.0	10.7	11.1	12.0
61	7	116	1	1	1	1X	13	13	0	0	0	0	0	0	0	0	0	52	.0	.0	4.1	4.8	5.2	5.5	5.7	5.9	6.1	6.6
61	7	117	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	0	6.4	7.4	8.5	9.7	10.5	11.2	11.6	12.3	12.9	13.5
61	7	118	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	3	3.7	5.1	6.8	8.7	9.2	10.3	11.0	11.7	12.4	13.5
61	7	119	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	3.9	5.1	6.3	7.0	7.7	8.2	8.8	9.3	9.8
61	7	120	1	1	1	11	12	14	0	0	0	0	0	0	0	0	0	0	5.4	6.0	7.2	7.8	7.9	8.4	8.5	8.7	8.8	8.9
61	7	121	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	14	.0	3.6	4.4	5.4	5.8	6.3	6.6	6.9	7.2	7.9
61	7	122	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.4	4.9	5.5	5.8	6.1	6.4	7.1
61	7	123	1	1	1	1X	11	13	0	0	0	9	0	0	0	0	0	0	4.0	4.8	5.9	6.7	7.4	8.0	8.5	8.9	9.2	9.4
61	7	124	1	1	1	1X	13	12	0	0	0	0	0	0	0	0	0	9	.0	.0	3.7	4.4	4.8	5.2	5.2	5.5	5.9	6.3
61	7	125	1	1	1	11	11	12	0	0	0	0	0	0	0	0	0	0	3.6	4.0	4.7	5.3	6.0	6.5	6.8	7.5	7.8	8.5
61	7	126	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	3.6	4.3	5.0	5.9	6.4	7.0	7.6	7.8	8.4	9.0
61	7	127	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	6.2	7.0	7.8	8.9	9.5	10.2	10.8	11.4	12.0	12.9
61	7	128	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.8	4.9	5.5	5.8	6.3	6.9	7.7	8.1
61	7	129	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	.0	3.7	5.0	6.3	7.5	7.7	8.3	8.6	9.1	9.5
61	7	130	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.9	4.8	5.2	5.6	5.9	6.2	6.6	7.3
61	7	131	1	1	1	10	13	13	0	0	0	0	0	0	0	0	0	0	.0	4.3	5.6	6.9	7.6	7.9	8.1	8.4	8.6	9.0
61	7	132	1	1	1	10	12	22	0	0	0	0	0	0	0	0	0	0	6.3	7.3	8.8	9.8	10.3	10.8	11.2	11.7	12.2	13.0
61	7	133	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	0	7.7	8.6	9.8	10.6	11.2	11.7	12.2	12.9	13.4	14.0
61	7	134	1	1	1	1X	10	22	0	0	0	0	0	0	0	0	0	0	7.0	7.8	9.0	10.0	10.2	11.3	11.7	12.3	12.7	13.2
61	7	135	1	1	1	10	12	13	0	0	0	0	0	0	0	0	0	0	3.8	4.6	5.4	6.4	6.8	7.1	7.5	7.7	7.9	8.3
61	7	136	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	0	8.0	8.9	10.2	10.9	11.5	12.0	12.5	13.0	13.6	14.2
61	7	137	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	3	3	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.0
61	7	138	2	2	2	43	44	44	0	0	0	0	30	0	31	0	0	0	29.2	29.4	29.7	29.8	30.0	30.2	30.3	30.4	30.6	30.7
61	7	139	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	7	140	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	7	141	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	7	142	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	4.0	4.9	.0	.0	4.0	4.9	5.9	7.9
61	7	143	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	0	3.6	5.1	7.1	8.8	10.1	11.0	11.7	12.6	13.2	14.4
61	7	144	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	34	.0	.0	.0	4.0	.0	.0	.0	4.0	4.5	6.5
61	7	145	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.6	5.1	5.5	6.0	6.4	6.9	7.3	7.8	8.3	8.7
61	7	146	1	1	1	10	22	23	0	0	0	0	0	0	31	0	34	3	8.6	9.6	10.9	11.7	12.5	13.0	13.3	13.7	14.0	14.3
61	7	147	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.4	5.2	5.8	6.7	7.6	8.6	10.4
61	7	148	1	1	1	1X	12	12	0	0	33	0	0	0	0	0	0	3	.0	.0	4.3	4.9	5.4	5.9	6.2	6.5	6.9	7.6
61	7	149	1	1	1	10	21	22	0	0	0	0	0	0	0	0	0	0	8.4	9.5	11.1	11.8	12.8	13.3	13.8	14.4	14.8	15.7
61	7	150	1	1	1	10	10	11	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.3	4.9	7.8	8.7	9.7	10.5	11.2	12.4
61	7	151	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.9	5.9	7.9
61	7	152	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.7	5.7	7.7
61	7	153	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.8	6.5	7.7	8.3	8.8	9.4	9.9	10.6
61	7	154	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	1	.0	.0	.0	.0	.0	.0	3.6	4.4	5.4	7.4
61	7	155	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.7	6.7
61	7	156	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	3.5	4.8	6.6	7.9	8.8	9.4	9.9	10.5	11.0	11.9
61	7	157	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	3.5	4.8	6.4	7.7	8.6	9.3	9.6	10.1	10.6	11.4
61	7	158	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	21	21	.0	.0	.0	.0	.0	.0	.0	4.0	4.5	6.5
61	7	159	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	33	34	.0	.0	.0	.0	.0	.0	3.6	4.5	5.5	7.5
61	7	160	1	1	1	10	12	13	0	0	0	0	0	0	0	0	0	0	5.9	6.8	8.0	9.0	9.6	10.1	10.5	11.0	11.3	11.7
61	7	161	1	1	1	11	10	11	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.5	5.4	5.6	6.3	7.2	8.1	9.0	9.9
61	7	162	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.8	5.3	7.3
61	7	163	1	1	1	1X	13	13	0	0	0	0	0	0	0	0	0	0	.0	.0	3.8	4.6	4.9	5.0	5.2	5.8	5.8	6.1
61	7	164	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.8	5.6	7.6
61	7	165	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.9
61	7	166	1	1	1	10	10	11	0	0	0	0	0	0	0	0	0	0	3.6	4.0	4.7	6.2	6.2	7.0	7.8	8.6	9.4	10.2
61	7	167	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	3	.0	.0	3.9	5.2	5.2	5.9	6.6	7.3	8.0	8.7
61	7	168	1	1	1	10	13	13	0	0	0	0	0	0	0	30	0	0	.0	4.0	4.7	5.7	6.1	6.6	6.6	6.7	6.8	7.1
61	7	169	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	33	53	.0	.0	.0	.0	.0	.0	4.0	4.7	5.7	7.7
61	7	170	1	1	1	10	10	11	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.5	5.0	6.0	6.6	7.4	8.1	8.7	9.7
61	7	171	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.1	6.1
61	7	172	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	2	.0	.0	.0	.0	.0	.0	4.0	5.1	6.1	8.1
61	7	173	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	20	.0	.0	4.0	4.8	5.6	6.4	7.2	8.0	8.7	9.6
61	7	174	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	20	20	.0	.0	.0	.0	.0	.0	4.0	5.1	6.1	8.1
61	7	175	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.6	5.6	7.6
61	7	176	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.7	5.2	5.6	6.5	7.4	8.4	9.3	10.4
61	7	177	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	.0	.0	3.6	4.5	5.5	7.7
61	7	178	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	7	179	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	3.7	4.6	5.8	6.5	7.3	7.6	7.8	8.2	8.5	9.0
61	7	180	1	1	1	10	21	21	0	0	0	0	0	0	0	0	0	0	9.1	10.3	11.9	13.0	14.0	14.6	15.2	15.9	16.5	17.6
61	7	181	1	1	1	11	13	13	0	0	0	0	0	0	0	0	0	0	.0	3.7	4.6	5.2	5.7	6.0	6.2	6.4	6.6	6.9
61	7	182	1	1	1	10	21	22	0	0	0	0	0	0	0	0	0	0	9.5	10.5	11.8	12.6	13.4	14.0	14.4	14.9	15.3	16.2
61	7	183	1	1	1	10	22	22	0	0	0	0	0	0	31	0	0	0	10.5	11.3	12.3	12.9	13.6	13.8	14.2	14.8	15.3	15.9
61	7	184	1	1	1	12	13	12	0	0	0	0	0	0	0	0	0	0	7.2	7.6	8.1	8.5	8.9	9.2	9.5	9.6	9.9	10.5
61	7	185	1	1	1	10	21	22	0	0	0	0	0	0	0	0	0	0	9.2	10.1	11.3	12.2	12.8	13.5	14.0	14.5	15.1	15.8
61	7	186	1	1	1	20	21	22	0	0	0	0	0	0	0	0	0	0	11.2	12.1	13.2	14.1	14.8	15.2	15.7	16.3	16.9	17.6
61	7	187	1	1	1	10	11	11	0	0	0	0	0	0	31	0	0	0	4.7	5.6	6.7	7.5	8.3	9.0	9.6	10.1	10.8	11.6
61	7	188	1	1	1	11	12	13	0	0	0	0	0	14	0	0	0	0	5.9	6.5	7.3	7.8	8.4	8.7	9.0	9.4	9.7	10.1
61	7	189	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	3	5.6	6.4	7.5	8.1	8.8	9.1	9.4	9.7	10.1	10.5
61	7	190	1	1	1	11	13	13	0	0	0	0	0	0	0	0	0	3	6.4	7.1	8.0	8.4	9.1	9.3	9.5	9.7	10.0	10.2

61	7	191	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.2
61	7	192	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	7	193	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.9
61	7	194	1	1	1	10	13	14	0	0	0	0	0	0	0	0	0	0	6.9	7.7	8.9	9.5	10.1	10.2	10.5	10.8	10.9	11.1
61	7	195	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	3	.0	4.1	4.9	5.4	5.8	6.3	6.5	6.7	7.0	7.5
61	7	196	1	1	1	11	13	12	0	0	0	0	0	0	0	0	0	0	3.6	4.8	5.6	6.4	6.6	6.9	7.2	7.4	7.7	8.2
61	7	197	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	4.7	5.2	5.6	5.9	6.2	6.5	7.0
61	7	198	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	33	.0	.0	3.7	4.5	5.0	5.5	5.8	6.1	6.5	7.2
61	7	199	1	1	1	10	11	21	0	0	0	0	0	0	0	0	0	0	6.2	7.1	8.2	9.0	9.8	10.4	11.0	11.5	12.1	13.0
61	7	200	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	3	5.0	5.6	6.0	6.5	6.8	7.1	7.4	7.5	7.7	8.0
61	7	201	1	1	1	10	12	22	0	0	0	0	0	0	0	0	0	0	8.1	8.9	9.9	10.5	11.2	11.6	11.9	12.4	13.0	13.5
61	7	202	1	1	1	10	12	12	0	14	0	0	0	0	0	0	0	0	4.7	5.5	6.3	7.1	7.8	8.2	8.5	9.0	9.3	9.8
61	7	203	1	1	1	1X	1X	10	0	0	0	0	0	0	0	30	3	3	.0	.0	.0	.0	.0	.0	4.1	5.2	6.1	7.9
61	7	204	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.0	6.1	8.1
61	7	205	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	11	.0	.0	.0	.0	.0	.0	.0	3.6	4.2	6.2
61	7	206	1	1	1	10	13	14	0	0	0	0	0	0	0	0	0	0	4.3	5.1	6.2	6.9	7.6	7.8	8.2	8.4	8.7	8.7
61	7	207	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	3	4.9	5.8	7.0	7.7	8.4	8.9	9.3	9.7	10.1	10.6
61	7	208	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	4.1	5.1	6.3	7.1	8.0	8.3	8.8	9.4	9.8	10.8
61	7	209	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	4.0	5.0	6.2	7.1	7.9	8.5	8.9	9.4	10.0	10.8
61	7	210	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.0	5.9	6.7
61	7	211	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.5	6.5
61	7	212	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.0
61	7	213	1	1	1	10	11	11	0	0	0	0	0	0	31	0	0	0	.0	3.8	4.7	5.8	6.7	7.5	8.0	8.7	9.3	10.2
61	7	214	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.2
61	7	215	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.2
61	7	216	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.9	5.9	7.9
61	7	217	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.5	5.5	7.5
61	7	218	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.1	4.8	5.8	6.3	6.5	7.4	8.3	9.2
61	7	219	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.3	5.0	5.6	6.4	7.2	8.4	9.6
61	7	220	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	7	221	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	4	4	.0	.0	.0	.0	.0	.0	.0	4.0	4.8	6.8
61	7	222	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	6.5	7.2	8.0	8.9	9.6	10.8
61	7	223	1	1	1	1X	1X	11	0	0	0	0	0	0	0	33	33	33	.0	.0	.0	.0	.0	4.0	5.0	6.0	6.7	7.5
61	7	224	1	1	1	1X	1X	11	0	0	0	0	0	0	0	20	20	20	.0	.0	.0	.0	.0	.0	4.0	4.6	4.8	6.3
61	7	225	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	14	14	.0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.7
61	7	226	2	2	2	42	43	43	0	0	0	0	0	62	0	0	0	0	24.2	24.5	24.8	25.1	25.4	25.5	25.7	25.8	26.1	26.3
61	7	227	1	1	1	1X	1X	31	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.8	5.4	7.2
61	7	228	1	1	1	10	10	11	0	0	0	0	0	0	0	0	0	0	.0	3.7	4.8	5.7	6.9	8.1	8.9	9.7	10.5	11.6
61	7	229	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	4	.0	.0	.0	.0	.0	.0	.0	.0	4.3	6.3
61	7	230	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	3.7	4.6	5.7	6.6	7.4	7.9	8.5	9.0	9.8
61	7	231	1	1	1	1X	1X	12	0	0	0	0	0	0	0	33	33	34	.0	.0	.0	.0	.0	4.0	5.0	5.5	6.0	6.8
61	7	232	2	2	2	42	44	44	0	3	0	0	0	0	0	0	0	0	29.3	29.6	30.1	30.2	30.5	30.5	30.6	30.7	30.7	30.7
61	7	233	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	6.8
61	7	234	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.6	4.5	5.5	6.3	8.0
61	7	235	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.8	5.4	6.2	7.9
61	7	236	2	2	2	42	44	44	0	0	0	0	0	0	3	0	0	0	30.5	30.8	31.3	31.4	31.7	31.8	31.8	32.0	32.0	32.1
61	7	237	2	2	2	43	44	44	0	0	2	9	0	0	31	0	0	13	21.0	21.2	21.4	21.6	21.8	22.0	22.0	22.1	22.3	22.5
61	7	238	2	2	2	33	34	34	0	13	0	0	0	14	0	0	0	0	28.7	29.0	29.4	29.4	29.7	30.0	30.0	30.0	30.2	30.2
61	7	239	2	2	2	44	44	44	0	0	74	0	0	0	30	2	0	92	29.6	30.0	30.0	30.0	30.2	30.2	30.2	30.2	30.2	30.2
61	7	240	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	4.0	4.9	5.9	6.9	8.6
61	7	241	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	0	6.6	7.4	8.6	9.7	9.8	11.5	12.1	12.8	13.5	14.4
61	7	242	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	5.0	5.8	6.3	8.0
61	7	243	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	7	244	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	4.7	5.8	7.1	8.0	9.0	9.7	10.3	10.9	11.4	12.2
61	7	245	1	1	1	10	11	22	0	33	2	0	0	0	31	0	0	0	5.9	7.1	8.3	9.1	9.7	10.2	10.6	11.2	11.6	12.3
61	7	246	1	1	1	10	22	22	0	33	0	0	0	33	0	3	0	0	10.5	11.2	12.0	12.7	13.4	13.7	14.1	14.5	14.8	15.3
61	7	247	1	1	1	10	11	21	0	0	0	0	0	0	0	0	0	0	6.5	7.4	8.5	9.1	9.9	10.4	10.9	11.4	12.0	12.9
61	7	248	1	1	1	20	21	22	0	0	0	0	0	0	0	0	0	0	13.4	14.2	15.2	15.9	16.5	17.3	17.5	18.3	18.8	19.5
61	7	249	1	1	1	20	21	22	0	0	0	0	0	0	0	0	0	0	11.2	12.6	13.9	15.0	15.8	16.6	17.0	17.7	18.3	19.0
61	7	250	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	6.1	7.0	8.2	9.0	9.6	10.2	10.5	11.0	11.3	11.8
61	7	251	1	1	1	11	13	13	0	0	0	0	0	0	0	0	0	0	.0	4.1	4.9	5.6	6.1	6.4	6.7	6.9	7.2	7.6
61	7	252	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	0	4.3	5.1	6.8	8.2	9.4	10.2	10.8	11.3	11.9	12.7
61	7	253	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	.0	3.7	4.6	5.0	5.6	6.0	6.5	7.0	7.8	8.4
61	7	254	1	1	1	10	21	23	0	0	0	0	0	0	0	0	0	0	6.9	5.2	9.8	11.1	12.1	12.8	13.6	14.0	14.3	14.7
61	7	255	1	1	1	10	10	13	0	0	0	0	0	0	0	0	0	0	.0	3.9	5.5	6.8	8.0	9.0	9.8	10.6	10.8	11.3
61	7	256	1	1	1	10	11	21	0	0	0	0	0	0	0	0	0	0	3.6	4.6	6.3	7.7	9.7	9.9	10.5	11.3	12.0	12.9
61	7	257	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	7	258	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	3	.0	3.6	4.1	5.0	5.5	6.0	6.5	7.0	7.7	8.5
61	7	259	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.4	5.4	6.1	6.8	7.6	7.8	8.2	8.8
61	7	260	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.0	4.4	5.2	6.0	6.8	7.6	8.7
61	7	261	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.0	5.9	7.6
61	7	262	1	1	1	10	21	22	0	33	0	0	0	3	0	0	0	3	9.0	10.0	11.3	11.9	12.8	13.3	13.9	14.5	15.0	15.9
61	7	263	1	1	1	20	21	22	0	0	0	0	0	0	0	0	0	0	10.8	11.8	12.9	13.8	14.7	15.6	15.9	16.6	17.1	18.0
61	7	264	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.7	5.2	7.0
61	7	265	1	1	1	1X	11	22	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	9.9	10.5	10.8	11.5	11.9	12.3
61	7	266	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.6	5.2	6.0	7.8
61	7	267	1	1	1	1X	1X	11	0	0	0	0	0	0	33	33	33	35	.0	.0	.0	.0	.0	4.0	5.0	5.5	6.0	7.3
61	7	268	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	33	35	.0	.0	.0	.0	.0	4.0	4.9	6.2	7.2	8.2
61	7	269	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	4.4	5.5	6.7	7.7	8.6	9.3	10.0	10.7	11.3	12.2
61	7	270	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.7	5.2	6.9
61	7	271	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	0	6.2	7.4	8.8	10.0	11.0	11.9	12.5	13.2	13.9	14.9
61	7	272	1	1	1	10	13	14	0	0	0	0	0	0	0	0	0	0	6.7	7.5	8.5	9.1	9.7	10.0	10.1	10.4	10.6	10.7
61	7	273	1	1	1	10	12	13	0	34	0	0	0	14	0	0	0	3	5.9	6.7	7.6	8.3	8.9	9.6	9.8	10.2	10.6	10.6
61	7	274	1	1	1	11	13	13	0	33	0	0	0	14	0	0	0	3	.0	3.7	4.4	4.8	5.2	5.5	5.7	5.9	6.1	6.5
61	7	275	1	1	1	12	14	13	0	33	0	0	0	14	0	0	0	4	3.6	4.2	4.7	5.0	5.1	5.3	5.4	5.5	5.6	6.0
61	7	276	1	1	1	11	12	12	0	33	0	0	0	0	0	0	0	0	7.0	7.6	8.3	8.8	9.4	9.9	10.1	10.7	11.1	11.7
61	7	277	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	3	5.8	6.4	7.3	7.6	8.2	8.6	8.9	9.3	9.6	10.1
61	7	278	1	1	1	11	23	23	0	33	0	0	0	0	0	0	0	3	9.9	10.4	11.2	11.6	11.9	12.2	12.2	12.4	12.7	13.0
61	7	279	1	1	1	12	14	14	0	0	0	0	0	0	0	0	0	3	6.9	7.3	7.9	8.3	8.5	8.7	8.7	8.8	8.8	8.9
61	7	280	1	1	1	20	21	21	0	0	0	0	0	0	0	0	0	0	11.6	12.6	13.6	14.4	15.4	16.2	16.6	17.3	17.9	19.1
61	7	281	1	1	1	10	22	22	0	0	0	0	0	0	0	0	0	0	8.0	9.1	10.5	11.4	12.3	12.9	13.2	13.7	14.3	14.9
61	7	282	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	6.1	6.9	7.8	8.5	9.3	9.8	10.3	10.7	11.2	11.8
61	7	283	1	1	1	20	22	22	0	35	3	0	0	0	0	0	0	0	12.0	12.8	13.7	14.3	15.1	15.7	16.1	16.5	16.9	17.8
61	7	284	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.8	4.9	6.1	7.0	7.9	8.8	9.6	10.6
61	7	285	2	2	2	43	44	44	0	21	0	0	0	64	0	0	24	94	31.2	31.4	31.7	31.8	32.0	32.0	32.0	32.0	32.0	32.0
61	7	286	2	2	2	44	4X	4X	0	0	0	0	91	0	0	0	0	0	32.8	32.8	32.8	32.8	32.8	.0	.0	.0	.0	.0
61	7	287	2	2	2	43	4X	4X	0	66	52	0	91	0	0	0	0	0	23.7	24.0	24.2	24.5	24.5	.0	.0	.0	.0	.0
61	7	288	2	2	2	42	43	4X	0	64	52	0	0	14	31	60	90	0	25.5	25.8	26.1	26.6	26.7	27.0	27.0	27.1	27.1	.0
61	7	289	2	2	2	42	44	4X	0	60	52	0	0	0	31	92	0	0	27.2	27.5	28.0	28.3	28.5	28.8	28.8	28.8	.0	.0
61	7	290	2	2	2	43	44	44	0	60	52	31	31	31	31	32	32	32	23.8	24.0	24.1	24.4	24.5	24.6	24.6	24.6	24.7	24.7

61	7	291	1	1	1	14	1X	1X	0	0	0	0	0	0	92	0	0	0	4.0	4.5	4.8	4.8	4.8	4.9	4.9	.0	.0	.0
61	7	292	1	1	1	1X	1X	1X	0	0	0	92	0	0	0	0	0	0	.0	5.5	6.6	6.8	.0	.0	.0	.0	.0	.0
61	7	293	1	1	1	1X	1X	1X	0	0	0	0	92	0	0	0	0	0	.0	.0	3.7	4.5	4.9	.0	.0	.0	.0	.0

TABLE 1.-:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	8	1	1	1	1	21	22	22	0	0	0	0	0	0	0	0	30	0	20.6	21.1	21.6	22.2	22.7	23.3	23.6	24.1	24.4	25.0
61	8	2	1	1	1	21	22	22	0	0	0	0	0	0	30	0	30	0	16.1	16.8	17.5	18.2	18.9	19.4	19.8	20.2	20.6	21.0
61	8	3	1	1	1	23	24	24	0	4	0	0	0	0	31	0	0	76	18.4	18.6	18.7	18.9	19.2	19.2	19.2	19.2	19.2	19.3
61	8	4	1	1	1	22	23	23	0	3	0	0	0	0	31	30	0	0	18.6	18.9	19.2	19.6	19.9	20.0	20.2	20.4	20.6	20.9
61	8	5	1	1	1	22	22	22	0	0	2	0	0	0	0	0	0	14	11.3	12.1	12.5	13.0	13.4	13.7	14.0	14.2	14.8	15.6
61	8	6	2	2	2	32	32	32	0	0	0	0	0	0	0	0	0	0	20.6	20.1	20.6	21.0	21.5	21.9	22.1	22.3	22.6	23.1
61	8	7	1	1	1	22	24	24	0	3	0	0	0	0	30	0	0	0	19.7	20.0	20.3	20.6	20.8	21.0	21.0	21.0	21.1	21.1
61	8	8	2	2	2	31	32	32	0	0	0	0	0	0	0	30	0	0	20.2	21.1	21.7	22.5	22.9	23.5	23.6	24.0	24.4	24.8
61	8	9	1	1	1	22	22	23	0	0	0	0	0	0	0	30	0	0	15.5	15.8	16.1	16.4	16.8	17.2	17.4	17.7	17.9	18.2
61	8	10	1	1	1	20	22	22	0	0	0	0	0	0	30	30	0	0	12.2	12.9	13.8	14.3	15.1	15.7	16.0	16.5	17.1	17.7
61	8	11	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.0	4.5	5.0	5.5	6.0	6.8	7.6
61	8	12	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.3	4.8	5.3	5.8	6.6	7.4
61	8	13	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.6	4.2	5.0	5.9	6.7	8.0
61	8	14	2	2	2	34	34	34	0	3	2	64	0	9	13	0	0	76	40.5	40.5	40.5	40.5	40.5	40.5	40.5	40.5	40.5	40.5
61	8	15	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.9	4.6	6.1
61	8	16	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.0	5.7	7.0
61	8	17	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	3.9	4.5	5.1	5.7	6.3	6.9	7.5	8.1	8.8	9.9
61	8	18	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.3	5.0	5.7	7.3
61	8	19	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.1	5.9	7.8
61	8	20	1	0	1	1X	44	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.9	5.8	7.4
61	8	21	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.1	5.9	6.6	7.2
61	8	22	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	4.3	4.9	5.6	6.2	6.8
61	8	23	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.7	6.0
61	8	24	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.4	5.3	6.1	7.0	7.8	9.5
61	8	25	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.2	4.8	5.4	6.0	6.6	7.2	7.8	9.0
61	8	26	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.0	7.5
61	8	27	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.9	4.8	6.0	7.8
61	8	28	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	6.8
61	8	29	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.0	6.0	7.8
61	8	30	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.8	5.8	7.6
61	8	31	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	.0	3.6	4.5	6.3
61	8	32	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.8	5.0	6.9
61	8	33	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.2	4.6	5.2	5.6	6.0	6.4	7.1
61	8	34	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.2	6.0
61	8	35	2	2	2	34	34	34	0	2	2	0	0	0	0	0	0	64	13.6	13.7	13.7	13.8	14.0	14.1	14.1	14.2	14.2	14.5
61	8	36	2	2	2	42	43	44	0	0	0	0	0	0	30	0	30	0	26.4	26.7	27.0	27.2	27.5	27.7	27.8	28.1	28.3	28.5
61	8	37	2	2	2	42	43	43	0	4	4	0	0	13	0	0	0	14	10.9	11.2	11.3	11.6	12.1	12.1	12.4	12.6	12.8	13.2
61	8	38	2	2	2	42	43	43	0	0	0	0	0	0	30	0	0	0	21.4	21.6	21.9	22.4	22.7	23.0	23.1	23.3	23.6	24.0
61	8	39	2	2	2	32	32	32	0	0	0	0	0	0	0	0	0	0	20.2	20.6	21.1	21.5	21.9	22.2	22.5	22.7	23.1	23.5
61	8	40	2	2	2	33	34	33	0	0	0	0	0	0	0	31	0	14	21.3	21.4	21.5	21.6	21.8	21.9	21.9	21.9	22.0	22.4
61	8	41	2	2	2	32	33	33	0	0	2	0	0	0	0	0	30	13	24.4	24.8	25.2	25.5	26.0	26.2	26.3	26.6	26.9	27.3
61	8	42	2	2	2	33	34	34	0	3	2	0	0	0	0	0	0	13	24.7	24.9	25.0	25.2	25.4	25.6	25.6	25.7	25.8	26.0
61	8	43	2	2	2	32	33	32	0	64	0	0	0	0	30	0	0	0	21.9	22.2	22.5	22.8	23.2	23.4	23.6	23.8	24.0	24.6
61	8	44	2	2	2	32	32	32	0	64	2	0	0	0	30	0	0	0	20.9	21.2	21.4	21.8	22.1	22.4	22.6	23.0	23.3	24.0
61	8	45	2	2	2	33	34	34	0	0	0	0	0	13	30	64	0	0	23.2	23.4	23.6	23.7	24.0	24.0	24.1	24.2	24.4	24.5
61	8	46	2	2	2	33	34	33	0	0	9	0	0	0	0	0	0	74	16.2	16.4	16.6	16.8	17.1	17.3	17.4	17.5	17.7	18.2
61	8	47	2	2	2	32	34	33	0	0	0	0	0	0	0	0	0	30	23.4	23.7	24.0	24.2	24.5	24.7	24.7	24.8	25.0	25.3
61	8	48	2	2	2	32	34	33	0	0	2	0	0	0	30	3	0	0	22.3	22.6	22.9	23.2	23.5	23.6	23.7	23.8	24.0	24.4
61	8	49	2	2	2	33	34	34	0	0	0	0	0	64	0	0	0	30	24.8	25.0	25.3	25.4	25.6	25.7	25.8	25.8	25.9	26.0
61	8	50	2	2	2	32	32	32	0	0	0	0	0	0	0	0	0	30	20.7	21.0	21.3	21.5	21.9	22.2	22.4	22.7	23.1	23.6
61	8	51	2	2	2	34	34	34	0	9	0	0	0	0	30	0	0	74	22.5	22.6	22.8	22.8	22.8	22.8	22.9	23.0	22.9	23.4
61	8	52	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	5.0	6.0	7.0	9.3
61	8	53	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.0	5.7	6.8
61	8	54	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.8	4.4	6.0
61	8	55	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.1	7.0
61	8	56	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	11	.0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.9
61	8	57	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.5
61	8	58	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.7	6.1
61	8	59	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.9	4.6	5.4	7.0
61	8	60	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	4.9	5.8	7.3
61	8	61	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	4.7	5.3	7.1
61	8	62	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.8	6.2
61	8	63	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.[illegible]	.0	.0	4.0	4.6	6.0
61	8	64	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.7	6.1
61	8	65	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.0	5.7	6.3	7.9
61	8	66	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.7	6.2
61	8	67	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.9	6.7
61	8	68	1	1	1	10	12	13	0	0	0	0	0	0	0	0	0	0	.0	4.0	4.7	5.6	[illegible].4	7.1	7.4	7.8	8.0	8.5
61	8	69	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	3.8	4.3	5.0	5.7	7.1
61	8	70	1	1	1	10	10	20	0	0	0	0	0	0	34	33	0	33	.0	3.6	5.2	7.1	8.[illegible]	9.6	10.4	11.3	12.0	13.5
61	8	71	1	1	1	1X	11	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	5.3	6.2	7.0	7.6	8.1	8.7	9.5
61	8	72	1	1	1	1X	13	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.4	5.9	6.2	6.2	6.5	6.9	7.7
61	8	73	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.8	6.2
61	8	74	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.6
61	8	75	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.9	5.2	5.6	5.9	6.2	6.6	7.0	7.4	7.7	8.4
61	8	76	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.6	5.9	6.9	7.9	8.5	9.3	9.8	10.9
61	8	77	1	1	1	20	20	22	0	0	0	0	0	0	0	0	0	13	27.4	28.4	29.5	30.5	31.4	32.0	32.8	33.6	33.9	35.0
61	8	78	2	2	2	31	32	33	0	0	2	0	0	0	0	0	0	13	28.2	28.7	29.4	29.7	30.2	30.6	30.8	31.1	31.3	31.8
61	8	79	1	1	2	22	24	34	0	0	2	0	0	0	0	0	0	0	21.7	22.0	22.3	22.7	22.[illegible]	23.0	23.1	23.2	23.2	23.2
61	8	80	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	5.4	6.3	7.2	7.8	8.5	9.1	10.0
61	8	81	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	3.6	[illegible].9	[illegible].3	7.6	[illegible]	9.6	10.2	10.9	11.5	12.3
61	8	82	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	4.3	5.4	6.7	7.8	8.7	9.5	9.9	10.6	11.1	11.7
61	8	83	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.7	6.0
61	8	84	1	1	1	1X	11	12	0	0	0	0	0	0	0	0	0	3	.0	.0	4.4	5.6	6.5	7.4	7.8	8.3	8.8	9.6
61	8	85	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	11	.0	.0	3.6	4.5	5.7	6.2	6.6	6.8	7.0	8.2
61	8	86	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	4.9	5.8	6.7	7.6	8.4	9.1	9.6	10.0	10.8	11.9
61	8	87	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	2	6.4	[illegible].6	6.[illegible]	7.0	7.2	7.4	7.6	7.8	8.0	8.3
61	8	88	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.1	4.6	5.2	5.5	6.0	6.4	6.7	7.2
61	8	89	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	4.[illegible]	5.2	5.8	6.3	6.8	7.3	7.3	7.8	8.3	9.2
61	8	90	1	1	1	12	14	12	0	0	0	0	0	0	0	0	0	0	4.0	4.5	5.0	5.4	5.9	6.0	6.0	6.2	6.6	7.3

```
61   8   91    1 1 1   12 13 13    0  0  0  0  0  0  0  0  0  0     4.6  4.9  5.3  5.6  5.9  6.2  6.4  6.6  6.8  7.2
61   8   92    1 1 1   10 11 21    0 64  0 33  0  0  0  0  0 33     7.0  7.9  8.9 10.0 10.6 11.3 12.0 12.7 13.3 14.4
61   8   93    1 1 1   10 20 21    0  2  0  0  0  0 20 20 20 20     7.0  8.2  9.4 10.7 11.7 12.3 13.1 14.0 14.8 15.9
61   8   94    1 1 1   10 11 11    0  0  0  0  0 33 20  0  0  0      .0  4.0  5.0  5.9  6.7  7.1  7.9  8.3  8.9  9.9
61   8   95    2 2 2   33 34 34    0 21 25  0  0  0 20  0  0 20    24.4 24.6 24.8 25.0 25.3 25.3 25.4 25.5 25.5 25.6
61   8   96    1 1 1   12 12 13    0  0  0  0  0  0  0  0  0  0     5.4  5.9  6.4  6.9  7.3  7.7  8.0  8.3  8.4  8.8
61   8   97    1 1 1   12 14 14    0 73  0  0  0  0  0  0  0 14     7.5  7.8  8.2  8.4  8.7  8.9  8.9  8.9  8.9  8.9
61   8   98    1 1 1   10 12 23    0  0  0  0  0 22 22 22 22  0     7.8  8.6  9.6 10.2 10.9 11.4 11.8 12.1 12.4 12.8
61   8   99    1 1 1   11 12 12    0  0  0  0  0  0  0  0  0  3     7.0  7.5  8.2  8.5  9.0  9.4  9.6  9.8 10.2 10.9
61   8  100    1 1 1   13 13 13    0  0  0  0  0  0  0  0  0  0     5.2  5.4  5.5  5.7  6.1  6.3  6.6  6.8  7.0  7.4

61   8  101    1 1 1   10 22 22    0  0  0  0  0  0  0  0  0  0     9.2  9.9 10.8 11.2 12.0 12.4 12.8 13.1 13.4 14.3
61   8  102    1 1 1   11 21 22    0  0  0  0  0  0 20  0  0  0     9.3  9.9 11.0 11.2 11.8 12.4 12.8 13.3 13.8 14.5
61   8  103    1 1 1   10 21 21    0  0  0  0  0  0  0  0  0  3     8.0  8.9 10.0 10.7 11.7 12.3 12.8 13.4 13.9 15.1
61   8  104    1 1 1   10 12 23    0 14  0  0  0  0  0  0  0  3     8.1  8.9  9.8 10.4 11.0 11.4 11.6 11.9 12.2 12.5
61   8  105    1 1 1   10 10 11    0  0  0  0  0  0  0  0  0  0      .0  3.8  5.6  7.2  8.3  9.0  9.9 10.5 11.3 12.4
61   8  106    1 1 1   11 11 11    0  0  0  0  0  0  0  0  0  0      .0  4.1  4.6  5.1  5.6  6.1  6.6  7.1  7.6  8.6
61   8  107    1 1 1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.8  5.2  7.4
61   8  108    1 1 1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.7  6.2
61   8  109    1 1 1   11 12 12    0  0  0  0  0  0  0  0  0  1      .0  4.2  4.7  5.3  5.8  6.2  6.7  7.2  7.4  8.0
61   8  110    1 1 1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.3  5.0  6.8

61   8  111    1 1 1   1X 11 11    0  0  0  0  0  0  0  0  0  3      .0   .0   .0  3.6  4.3  4.9  5.5  6.2  6.8  8.0
61   8  112    2 2 2   32 33 32    0  4  0  0  0  3  0  0  0  0    17.7 18.1 18.6 18.9 19.4 19.6 19.8 20.0 20.4 21.1
61   8  113    1 1 1   21 22 22    0  0  0  0  0  0 30  0  0  0    17.6 18.1 18.6 19.0 19.7 20.0 20.4 20.8 21.1 21.8
61   8  114    1 1 1   10 20 21    0  0  0  0  0  0  0  0  0  0     9.0 10.0 11.2 12.2 12.9 13.7 14.3 15.0 15.7 16.5
61   8  115    1 1 1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.1  4.7  5.5  6.4  8.1
61   8  116    1 1 1   22 22 22    0  0  0  0  0  0  0  0  0 30    14.7 15.2 15.6 16.2 16.7 16.9 17.2 17.5 17.8 18.3
61   8  117    1 1 2   22 24 32    0  2  0  0  0  0  0  0  0  0    11.6 11.9 12.0 12.3 12.7 12.8 12.9 13.0 13.2 14.0
61   8  118    1 1 1   12 13 12    0  2  0  0  0 14  0  0  0  0     6.1  6.5  6.7  7.1  7.6  7.8  8.0  8.3  8.7  9.3
61   8  119    1 1 1   20 22 22    0  0  0  0  0  0  0  0  0  0    22.3 23.0 23.8 24.5 25.2 25.7 26.1 26.5 26.8 27.6
61   8  120    1 1 1   21 22 22    0  0  0  0  0  0  0  0  0  0    17.9 18.6 19.3 20.0 20.7 21.2 21.5 21.9 22.3 23.1

61   8  121    1 1 2   22 22 32    0  3 52  0  0  0 30 30  0 30    25.0 25.5 26.0 26.5 26.9 27.2 27.5 27.7 28.1 28.5
61   8  122    1 1 1   1X 10 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  3.6  4.6  5.6  6.5  7.9  9.0
61   8  123    1 1 1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.7  4.6  6.8
61   8  124    2 2 2   33 33 34    0  3 52  0  0  9  0  0 30  0    28.5 28.7 28.9 29.2 29.4 29.6 29.6 29.8 29.9 30.1
61   8  125    2 2 2   33 33 34    0 64  0  0  0  0  0  0  0  0    32.3 32.5 32.7 33.0 33.1 33.4 33.5 33.8 33.8 34.2
61   8  126    2 2 2   34 34 34    0  4  0  0  0 14  0  0  0  0    18.1 18.2 18.4 18.4 18.5 18.8 18.8 18.9 19.0 19.0
61   8  127    2 2 2   32 32 32    0 64  0  0  0 13 30  0  0 14    23.2 23.6 24.1 24.4 24.8 25.2 25.4 25.7 26.1 26.9
61   8  128    2 2 2   32 33 33    0 64 -2  0  0  0 30  0  0  0    20.3 20.6 20.9 21.2 21.5 21.7 21.9 22.1 22.2 22.7
61   8  129    2 2 2   32 32 32    0 64  0  0  0  0 30  0  0  0    17.4 17.9 18.3 18.8 19.3 19.8 20.1 20.5 20.8 21.4
61   8  130    2 2 2   33 33 33    0 64  0  0  0  0  0  0  0  0    16.3 16.6 16.9 17.2 17.4 17.7 17.8 17.9 18.3 18.6

61   8  131    2 2 2   32 34 33    0  0  0  0  0  0  0  0  0  0    22.0 22.3 22.6 23.0 23.2 23.4 23.5 23.5 23.6 24.0
61   8  132    2 2 2   34 34 34    0  3  4  0  0 14  0  0  0  0    14.1 14.2 14.2 14.3 14.5 14.5 14.5 14.6 14.7 14.7
61   8  133    2 2 2   32 33 34    0  0  0  0  0  0  0  0  0  3    26.7 27.0 27.5 27.8 28.0 28.3 28.3 28.5 28.5 28.5
61   8  134    2 2 2   34 34 34    0  0 30  0  0  0  0  0  0 14    21.9 22.0 22.1 22.3 22.4 22.5 22.6 22.6 22.6 22.9
61   8  135    2 2 2   34 34 34    0  0  0  0  0  0  0  0  0  4    11.5 11.5 11.5 11.6 11.6 11.7 11.7 11.8 11.8 11.8
61   8  136    1 1 1   22 22 33    0  0  0  0  0  3 30  0  0 30    23.9 24.3 24.9 25.1 25.4 25.9 26.0 26.2 26.4 26.7
61   8  137    1 1 2   22 24 34    0  0  0  0  0  0 30  0  0 30    25.8 26.1 26.5 26.7 27.0 27.1 27.2 27.4 27.5 27.6
61   8  138    1 1 1   11 12 22    0  0  0  0  0  0  0  0  0  0     8.9  9.4 10.0 10.4 10.9 11.3 11.5 11.8 12.2 12.6
61   8  139    1 1 1   22 22 22    0  0  0  0  0  0  0  0  0  0    12.1 12.5 12.9 13.3 13.7 14.1 14.4 14.7 15.0 15.5
61   8  140    1 1 1   13 13 23    0  0  0  0  0 14  0  4  0  0    10.3 10.5 10.7 10.9 11.2 11.4 11.6 11.7 12.0 12.3

61   8  141    1 1 1   22 24 22    0  0  0  0 30  0 30  0  0  0    11.9 12.2 12.5 12.7 13.1 13.2 13.2 13.2 13.3 14.0
61   8  142    1 1 1   21 22 22    0  0  0  0  0  0  0  0  0  0    11.4 11.9 12.5 13.0 13.4 14.0 14.3 14.7 14.9 15.7
61   8  143    1 1 1   22 22 22    0  0  0  0  0  0  0  0  0  3    20.6 21.0 21.4 21.8 22.3 22.7 23.1 23.3 23.5 24.1
61   8  144    1 1 1   24 24 24    0  3 73  0  0  9 30  0  0  0    11.8 11.9 12.0 12.0 12.0 12.0 12.0 12.0 12.0 12.2
61   8  145    1 1 1   22 22 23    0 73  0  0  0  0 30  0  0  0    13.4 13.8 14.2 14.6 15.0 15.4 15.6 15.9 16.1 16.5
61   8  146    1 1 1   22 23 23    0  0  0  0 30  0 30  0  0 13    13.3 13.7 14.2 14.5 14.8 15.0 15.2 15.5 15.8 16.2
61   8  147    1 1 1   11 12 22    0  0  0  0  0  0  0  0  0  0     8.2  8.7  9.2  9.6 10.2 10.6 10.8 11.3 11.6 12.2
61   8  148    1 1 1   22 23 22    0  0  0  0  0  0  0  0  0  0    15.9 16.4 16.9 17.2 17.8 17.9 18.2 18.5 18.8 19.3
61   8  149    1 1 1   21 21 22    0  0  0  0  0  0 30  0  0  0    14.5 15.1 15.8 16.5 16.9 17.7 18.1 18.6 19.3 19.9
61   8  150    2 2 2   33 34 34    0  0 52  0  0  0 30  0  0  0    24.8 25.0 25.2 25.3 25.5 25.6 25.6 25.7 25.7 25.8

61   8  151    1 1 1   22 22 22    0  0  0  0  0  0  0  0  0  0    12.9 13.2 13.5 13.9 14.2 14.6 14.8 15.1 15.4 16.2
61   8  152    1 1 2   22 23 33    0  0  0  0  0  0  0  0  0  0    18.4 18.7 19.1 19.3 19.6 19.9 20.1 20.4 20.4 20.8
61   8  153    1 1 2   24 24 34    0  3  0  0  0  0  0  0  0  0    17.2 17.3 17.3 17.3 17.3 17.3 17.4 17.4 17.5 17.5
61   8  154    1 1 2   22 23 34    0  3  0  0  0  0 63  0  0  0    22.5 22.8 23.4 23.5 23.8 24.1 24.1 24.3 24.4 24.5
61   8  155    1 1 2   24 24 34    0  0  0  0  0  0 30  3  0  0    27.0 27.1 27.2 27.4 27.4 27.4 27.4 27.4 27.4 27.4
61   8  156    1 1 1   22 23 22    0  0  0  0  0  0 30  0 30  0    20.8 21.1 21.6 21.9 22.1 22.6 22.6 22.9 23.2 23.7
61   8  157    1 1 1   12 12 12    0  0  0  0  0  0  0  0  0  0     5.4  5.9  6.4  6.8  7.3  7.7  7.9  8.3  8.6  9.6
61   8  158    1 1 1   22 23 23    0  0  0  0  0  0  0  0  0  0    20.2 20.6 20.9 21.3 21.8 22.1 22.3 22.5 22.8 23.2
61   8  159    1 1 1   22 22 23    0  0  0  0  0  0 30  0 30 30    21.0 21.4 21.9 22.5 22.5 23.0 23.1 23.4 23.6 24.0
61   8  160    1 1 1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  3.6  4.5  5.6  8.0

61   8  161    1 1 1   1X 1X 10    0  0  0  0  0  0  0  0  0 14      .0   .0   .0   .0   .0   .0   .0  4.0  4.9  6.8
61   8  162    1 1 1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  3.6  4.4  5.3  6.0  7.8
61   8  163    1 1 1   10 12 12    0  0  0  0  0  0  0  0  0  0     4.2  4.9  5.7  6.3  7.1  7.5  7.8  8.2  8.5  9.0
61   8  164    1 1 1   10 12 12    0  0  0  0  0  0  0  0  0  2     4.7  5.4  6.3  6.9  7.5  8.1  8.3  8.7  9.1  9.6
61   8  165    1 1 1   12 13 14    0  0  0  0  0  0  0  0  0  0      .0  3.6  4.3  4.7  5.0  5.4  5.4  5.6  5.8  6.0
61   8  166    1 1 1   10 12 12    0 35  0  0  0  0  0  2  0  0     6.7  7.4  8.3  9.0  9.6 10.0 10.3 10.7 11.2 11.8
61   8  167    1 1 1   10 11 11    0  0  0  0  0  0  0  0  0  0     5.4  6.3  7.3  8.2  9.0  9.5 10.0 10.7 11.4 12.5
61   8  168    1 1 1   10 11 21    0  0  0  0  0  0  0  0  0  0     6.3  7.2  8.3  9.2  9.8 10.6 11.2 11.8 12.4 13.3
61   8  169    1 1 1   1X 1X 10    0  0  0  0  0  0  0  0  0 14      .0   .0   .0   .0   .0   .0  3.9  4.4  5.3  7.0
61   8  170    1 1 1   10 11 21    0 21 33  0  0  0  0  0  0  3     6.8  7.6  8.5  9.3 10.1 10.6 11.1 11.7 12.3 13.2

61   8  171    1 1 1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.9  5.0  7.2
61   8  172    1 1 1   14 12 14    0  0  0  0  0  0  0  0  0  0     6.5  6.8  7.1  7.4  6.7  7.0  7.3  7.6  7.9  8.0
61   8  173    1 1 1   11 12 11    0  0  0  0  0  0  0  0  0  0     6.2  6.8  7.3  7.9  8.5  8.8  9.2  9.6 10.1 11.1
61   8  174    1 1 1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0  4.2  6.1  7.3  8.5  9.3 10.1 11.0 12.0
61   8  175    2 2 2   43 4X 4X    0 64 -2  9  0  0 92  0  0  0    30.1 30.3 30.5 30.7 30.8 30.9 30.9   .0   .0   .0
61   8  176    2 2 2   43 4X 4X    0 64 52  0  0  0 92  0  0  0    34.3 34.4 34.5 34.7 34.8 34.9 34.9   .0   .0   .0
61   8  177    2 2 2   34 3X 3X    0 64  0  0  0 42 93  0  0  0    22.0 22.1 22.3 22.5 22.5 22.6 22.8   .0   .0   .0
61   8  178    2 2 2   34 3X 3X    0 64  0  0  0 92  0  0  0  0    24.2 24.2 24.3 24.3 24.3 24.3   .0   .0   .0   .0
61   8  179    2 0 2   4X 44 4X    0  0 90  0  0  0  0  0  0  0    23.9 23.9 23.9 30.2   .0   .0   .0   .0   .0   .0
61   8  180    2 2 2   33 34 3X    0  0  0  0  0 13  0  0 92  0    16.7 16.7 16.9 17.0 17.1 17.1 17.2 17.3 17.3   .0

61   8  181    2 2 2   34 3X 3X   20 65 52  0  0  9 90  0  0  0    18.5 18.6 18.7 18.8 18.9 18.9 18.9   .0   .0   .0
61   8  182    1 1 1   1X 1X 1X    0  9 95  0  0  0  0  0  0  0     9.4  9.4  9.4   .0   .0   .0   .0   .0   .0   .0
61   8  183    1 1 1   24 2X 2X    0  0  0  0 92  0  0  0  0  0    12.4 12.6 12.6 12.6 12.6   .0   .0   .0   .0   .0
61   8  184    1 1 1   1X 1X 1X    0  4  0 95  0  0  0  0  0  0     9.4  9.4  9.5  9.5   .0   .0   .0   .0   .0   .0
61   8  185    1 1 1   12 14 1X    0 35 35 35 35 35 35 98  0  0     3.6  4.3  4.7  5.0  5.1  5.3  5.3  5.3   .0   .0
61   8  186    2 2 2   44 44 4X    0  0  0  0  0  0  0 90  0  0    21.3 21.3 21.3 21.3 21.4 21.4 21.4 21.4   .0   .0
61   8  187    2 2 2   43 4X 4X   24 24 24 24 91  0  0  0  0  0    26.5 26.9 27.3 27.6 27.6   .0   .0   .0   .0   .0
61   8  188    2 2 2   4X 4X 4X    0  0 92  0  0  0  0  0  0  0    37.2 37.3 37.3   .0   .0   .0   .0   .0   .0   .0
```

TABLE 1.9:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	9	1	1	1	1	20	20	21	0	33	0	0	0	0	0	0	0	0	11.3	12.5	13.9	14.8	15.9	16.7	17.5	18.5	19.2	20.5
61	9	2	1	1	1	10	21	22	0	0	0	0	0	0	0	0	0	0	9.2	10.2	11.4	12.3	13.1	13.7	14.1	14.7	15.4	16.2
61	9	3	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	5.6	6.5	7.5	8.1	9.1	9.6	9.9	10.3	10.7	11.3
61	9	4	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	.0	3.9	5.0	5.9	6.7	7.2	7.8	8.4	9.0	9.9
61	9	5	1	1	1	10	22	22	0	0	0	0	0	0	0	0	0	0	7.5	8.9	10.5	11.6	13.1	13.4	13.9	14.4	15.1	15.4
61	9	6	1	1	1	10	12	12	0	33	2	0	0	0	0	0	0	0	.0	4.3	5.8	6.6	7.4	7.8	8.2	8.5	9.0	9.6
61	9	7	1	1	1	10	21	22	0	0	0	0	0	0	0	0	0	0	7.6	8.7	10.2	11.2	12.1	12.7	13.3	14.0	14.5	15.2
61	9	8	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.9	5.3	5.8	6.2	6.7	7.1	7.5	8.0	8.5	9.3
61	9	9	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.3	5.7	6.0	6.3	6.7	7.0	7.3	7.7	8.1	8.7
61	9	10	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.9	4.2	4.6	4.8	5.2	5.5	6.0
61	9	11	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.0	4.3	4.6	5.0	5.4	5.7	6.0	6.5
61	9	12	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	.0	3.9	4.3	4.8	5.2	5.6	6.0	6.4	6.7	7.2
61	9	13	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	4.9	5.4	6.0	7.7
61	9	14	1	1	1	10	22	22	0	33	0	0	0	0	0	0	0	3	9.1	10.1	11.3	12.2	13.1	13.7	14.0	14.5	15.1	15.7
61	9	15	1	1	1	10	22	22	0	0	0	0	0	0	0	0	0	0	9.5	10.3	11.2	11.9	12.7	13.1	13.4	13.8	14.5	15.0
61	9	16	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	5.4	6.1	6.9	7.6	8.2	8.7	9.0	9.5	10.0	10.7
61	9	17	1	1	1	12	14	14	0	0	0	0	0	0	0	0	0	0	4.6	4.9	5.3	5.6	5.9	5.9	6.0	6.0	6.1	6.2
61	9	18	1	1	1	12	13	13	0	33	0	0	0	0	0	0	0	0	5.0	5.4	5.8	6.1	6.4	6.8	7.0	7.1	7.3	7.6
61	9	19	1	1	1	10	21	21	0	0	0	0	0	0	0	0	0	0	9.1	9.8	10.6	11.3	12.0	12.6	13.0	13.5	14.1	15.1
61	9	20	1	1	1	10	13	13	0	33	2	0	0	0	0	0	0	33	5.2	5.9	6.6	7.3	8.1	8.3	8.6	8.8	9.0	9.4
61	9	21	1	1	1	11	12	23	0	0	0	0	0	0	33	0	0	0	8.6	8.8	9.5	10.1	10.7	11.2	11.5	11.9	12.1	12.6
61	9	22	1	1	1	11	12	22	0	33	0	0	0	0	0	0	0	0	7.9	8.5	9.2	9.7	10.3	10.8	11.2	11.7	12.1	12.9
61	9	23	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	0	7.7	8.5	9.5	10.4	11.0	11.7	12.1	12.5	12.9	13.8
61	9	24	1	1	1	12	14	14	0	33	33	0	0	0	0	0	0	4	6.1	6.5	7.0	7.4	7.7	7.9	8.0	8.0	8.2	8.2
61	9	25	1	1	1	10	12	12	0	13	0	0	0	11	0	0	0	0	7.1	7.9	8.9	9.7	10.4	10.8	11.3	11.6	12.1	12.6
61	9	26	1	1	1	22	23	22	20	20	20	20	20	21	21	21	21	21	23.2	23.5	23.9	24.1	24.5	24.8	24.9	25.0	25.4	25.8
61	9	27	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	3.9	5.3	6.6	7.7	8.4	9.0	9.6	10.1	11.0
61	9	28	1	1	1	10	12	12	0	0	0	0	0	0	34	0	0	3	.0	4.0	5.3	6.4	7.4	7.9	8.2	8.7	9.2	9.9
61	9	29	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.8	6.1	7.0	7.6	8.5	9.3	10.6
61	9	30	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	.0	3.8	5.3	6.6	7.7	8.2	8.9	9.7	10.5	11.5
61	9	31	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.4
61	9	32	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	5.5	6.5	7.4	7.9	8.5	9.1	10.1
61	9	33	1	1	1	12	13	12	0	0	0	0	0	0	0	0	0	3	5.6	6.0	6.4	6.8	7.0	7.2	7.4	7.6	7.8	8.5
61	9	34	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.1
61	9	35	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	3.6	6.1
61	9	36	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.5	6.5
61	9	37	2	2	2	33	34	34	0	20	3	64	0	0	0	0	0	0	24.3	24.5	24.7	24.9	25.1	25.2	25.3	25.4	25.5	25.6
61	9	38	2	2	2	33	34	34	0	0	0	0	0	0	62	0	0	13	29.3	29.6	29.9	30.2	30.4	30.5	30.5	30.5	30.5	30.7
61	9	39	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	.0	3.9	4.7	5.5	6.4	7.2	7.8	8.4	9.1	10.0
61	9	40	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.7	4.5	6.0
61	9	41	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.2	6.9
61	9	42	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.5	6.0
61	9	43	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	.0	.0	4.3	5.0	5.8	7.2
61	9	44	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.8	4.5	5.2	5.9	7.1
61	9	45	1	1	1	10	10	11	0	0	0	0	0	0	0	0	0	0	.0	4.5	5.5	6.5	7.6	8.4	9.1	9.8	10.5	11.6
61	9	46	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.3	6.5
61	9	47	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.0	5.9	7.4
61	9	48	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.1
61	9	49	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.9	4.8	6.5
61	9	50	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.0	5.7	7.2
61	9	51	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.8	6.3	7.7	8.7	9.6	10.4	11.2	12.4
61	9	52	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	0	5.8	7.0	8.6	9.6	10.7	11.6	12.5	13.3	13.9	15.3
61	9	53	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	4.9	5.6	7.0
61	9	54	1	1	1	12	13	12	0	0	0	0	0	0	0	0	0	34	6.6	6.9	7.2	7.5	7.8	7.8	8.1	8.4	8.7	9.2
61	9	55	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.1	4.7	5.2	5.9	7.4
61	9	56	2	2	2	34	34	34	0	0	0	0	0	0	30	0	0	0	24.8	25.0	25.2	25.3	25.4	25.4	25.5	25.5	25.5	25.6
61	9	57	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.5	4.9	5.3	5.7	6.1	6.5	6.9	7.3	7.7	8.5
61	9	58	1	1	1	21	22	22	0	0	0	0	0	0	30	0	0	0	20.7	21.3	21.9	22.6	23.2	23.7	24.1	24.4	25.1	25.7
61	9	59	1	1	1	23	23	24	0	0	0	0	0	0	30	0	0	0	15.8	16.0	16.3	16.4	16.7	16.9	17.0	17.1	17.3	17.3
61	9	60	1	1	1	21	22	22	0	0	0	0	0	0	30	0	0	0	18.2	18.7	19.3	19.8	20.3	20.8	21.1	21.4	21.8	22.4
61	9	61	1	1	1	13	14	14	0	0	0	0	0	2	0	0	0	4	8.8	9.0	9.2	9.3	9.5	9.5	9.6	9.7	9.8	9.7
61	9	62	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.2
61	9	63	1	1	1	21	22	22	0	0	0	0	0	0	31	0	30	0	18.5	19.2	19.7	20.3	21.2	21.5	21.9	22.1	22.7	23.3
61	9	64	1	1	1	24	24	24	0	4	0	0	0	9	31	0	0	0	11.5	11.7	11.8	11.8	11.9	12.0	12.0	12.0	12.1	12.2
61	9	65	1	1	1	10	20	22	0	0	0	0	0	0	0	0	0	0	8.1	9.2	10.6	11.6	12.5	13.2	13.8	14.6	15.3	16.0
61	9	66	1	1	1	1X	12	13	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	6.2	6.5	6.8	7.1	7.4	7.6
61	9	67	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	9	.0	.0	.0	.0	.0	.0	.0	4.2	4.9	6.5
61	9	68	1	1	1	10	10	10	0	0	0	0	0	0	0	0	0	0	.0	3.6	5.0	6.1	7.3	8.2	9.0	10.0	10.8	12.1
61	9	69	1	1	1	21	23	22	0	0	0	0	0	0	30	0	0	0	16.2	16.9	17.5	18.1	18.9	18.9	19.5	19.6	20.1	20.9
61	9	70	1	1	1	21	22	22	0	0	0	0	0	0	30	0	0	0	12.9	13.5	14.2	14.8	15.2	15.7	16.0	16.4	16.8	17.4
61	9	71	1	1	1	22	23	23	0	0	0	0	0	0	0	0	0	3	16.2	16.5	16.8	17.1	17.4	17.6	17.6	17.9	18.1	18.6
61	9	72	1	1	1	23	23	21	0	0	0	0	0	0	30	0	0	0	12.4	12.6	12.8	13.0	13.1	13.2	13.6	13.9	14.4	15.4
61	9	73	1	1	1	20	21	21	0	0	0	0	0	0	30	0	0	0	18.6	19.3	20.0	20.7	21.5	22.2	22.6	23.2	23.8	24.7
61	9	74	1	1	1	22	24	23	0	0	0	0	0	0	0	0	0	0	14.8	15.1	15.5	15.7	16.1	16.3	16.4	16.4	16.9	17.0
61	9	75	1	1	2	13	24	34	0	73	0	0	0	11	0	9	0	0	10.7	10.9	11.1	11.3	11.6	11.7	11.7	11.7	11.7	11.8
61	9	76	1	1	1	21	22	22	0	0	0	0	0	0	30	0	0	0	13.7	14.2	15.0	15.3	15.8	16.2	16.4	16.8	17.2	17.6
61	9	77	1	1	1	22	22	23	0	0	0	0	0	0	30	0	0	0	16.7	17.1	17.5	17.9	18.3	18.5	18.8	19.1	19.4	19.8
61	9	78	1	1	1	23	23	24	0	3	0	0	0	0	30	0	0	0	20.5	20.7	21.0	21.2	21.4	21.6	21.7	21.8	21.8	21.8
61	9	79	1	1	1	10	20	21	0	0	0	0	0	0	0	0	0	0	9.3	10.3	11.6	12.6	13.4	14.3	14.8	15.5	16.2	17.1
61	9	80	1	1	1	10	22	22	0	33	0	0	0	14	0	0	0	0	9.0	9.9	11.3	12.0	12.6	13.3	13.5	14.0	14.5	14.9
61	9	81	1	1	1	10	12	13	0	0	0	0	0	0	0	0	0	33	.0	3.9	4.8	5.3	6.0	6.3	6.3	7.4	7.6	8.0
61	9	82	1	1	1	10	12	23	0	0	0	0	0	0	0	0	0	21	7.5	8.4	9.8	10.4	11.2	11.6	11.9	12.2	12.5	12.9
61	9	83	1	1	1	11	13	13	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.1	4.6	5.1	5.3	5.5	5.7	5.9	6.3
61	9	84	1	1	1	20	20	21	0	0	0	0	0	0	0	0	0	0	11.0	12.1	13.6	14.7	15.5	16.4	16.9	17.6	18.2	19.2
61	9	85	1	1	1	10	12	23	0	0	0	0	0	0	0	0	0	0	7.9	8.8	9.8	10.6	11.4	11.7	12.1	12.6	13.0	13.3
61	9	86	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	0	6.7	7.7	9.0	10.0	10.8	11.8	12.0	12.6	13.1	13.7
61	9	87	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	0	6.8	7.7	8.8	9.7	10.5	11.0	11.4	12.1	12.6	13.5
61	9	88	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	2	6.1	6.8	7.8	8.4	8.9	9.4	9.7	10.0	10.4	10.8
61	9	89	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	2	.0	4.2	4.6	4.9	5.2	5.5	5.8	6.0	6.3	6.8
61	9	90	1	1	1	11	12	12	0	35	0	0	0	0	0	0	0	0	4.9	5.6	6.5	7.0	7.7	8.1	8.4	8.8	9.2	9.8

```
61  9   91   1  1  1   10 10 11    0 33  0  0  0  0 34  0  0  0    4.2  5.3  6.5  7.6  8.6  9.5 10.2 10.8 11.5 12.4
61  9   92   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     .0  4.4  5.3  6.1  7.0  7.8  8.2  8.9  9.4 10.0
61  9   93   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0  4.1  6.3
61  9   94   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.1  5.0  5.9  7.2
61  9   95   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.8  4.3  4.9  6.1
61  9   96   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  3     .0   .0   .0   .0   .0   .0  4.1  5.0  6.0  7.8
61  9   97   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.1  5.0  6.7
61  9   98   1  1  1   12 12 13    0  0  0  0  0  0  0  0  0  2    5.4  5.7  6.0  6.3  6.6  6.9  7.2  7.5  7.8  8.1
61  9   99   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.0  4.6  5.3  6.9
61  9  100   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.4

61  9  101   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0  4.2  6.0
61  9  102   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  3     .0   .0   .0   .0   .0   .0   .0  3.8  6.0  8.3
61  9  103   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  3     .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.5
61  9  104   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.1  5.0  6.5
61  9  105   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.2  5.0  5.9  7.4
61  9  106   1  1  1   10 10 11    0  0  0  0  0  0  0  0  0  0     .0  3.5  4.6  5.[illegible]  6.9  7.8  8.3  9.0  9.7 10.6
61  9  107   1  1  1   10 20 21    0  0  0  0  0  0  0  0  0  0    8.0  9.2 10.6 11.7 12.7 13.5 14.0 14.8 15.6 16.7
61  9  108   1  1  1   1X 12 12    0  0  0  0  0  0  0  0  0  0     .0   .0  3.9  4.6  5.3  5.9  6.2  6.4  6.7  7.2
61  9  109   1  1  1   10 11 21    0  0  0  0  0  0  0  0  0  0    6.1  7.3  8.7 10.0 11.0 11.7 12.4 12.7 13.3 14.2
61  9  110   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  3.6  4.3  6.0

61  9  111   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  3.7  4.9  7.1
61  9  112   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0  4.3  5.0  5.7  6.2  7.8
61  9  113   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0  4.2  6.0
61  9  114   1  1  1   23 23 23    0 21 25  0  0  0 30 30 30 30   22.7 22.9 23.1 23.3 23.6 23.9 23.9 24.1 24.3 24.6
61  9  115   1  1  1   24 24 24    0 21 25  0  0  0 30 30 30 30   23.0 23.1 23.2 23.3 23.4 23.4 23.4 23.4 23.5 23.5
61  9  116   1  1  1   24 24 24    0 21 25  0  0  0 22 22 22  0   29.4 29.5 29.8 29.8 29.[illegible] 29.8 29.9 29.9 29.9 30.0
61  9  117   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  9     .0   .0   .0   .0   .0   .0   .0   .0  4.1  6.0
61  9  118   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 33     .0   .0   .0   .0   .0   .0   .0  3.8  5.0  7.2
61  9  119   1  1  1   11 10 21    0  0  0  0  0  0 34  0  0  3    7.[illegible]  8.1  9.0  9.6 10.1 11.8 12.2 13.0 13.7 14.5
61  9  120   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.0  4.7  6.3

61  9  121   1  1  1   12 14 13    0  0  0  0  0  0  0  0  0  0     .0  4.2  4.6  4.8  5.0  5.2  5.2  5.4  5.8  6.1
61  9  122   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 14     .0   .0   .0   .0   .0   .0  3.9  4.6  5.3  7.1
61  9  123   1  1  1   11 14 13    0  0  0  0  0  0  0  0  0  0     .0  3.9  4.7  5.3  5.[illegible]  6.1  6.1  6.2  6.4  6.9
61  9  124   1  1  1   10 21 22    0  0  0  0  0  0  2  0  0  0    8.5  9.4 10.3 11.2 12.0 12.6 13.1 13.6 14.1 14.6
61  9  125   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0    5.9  6.7  7.[illegible]  8.4  9.1  9.6 10.3 10.8 11.1 12.0
61  9  126   1  1  1   10 11 11    0  0  0  0  0  0  0  0  0  0    4.2  5.0  5.8  6.5  7.3  7.8  8.5  8.9  9.5 10.6
61  9  127   1  1  1   10 10 21    0  0  0  0  0  0  0  0  0  0    5.7  6.7  7.8  8.8  9.8 10.6 11.2 12.0 12.7 13.7
61  9  128   1  1  1   21 22 22    0  0  0  0  0 11  0  0  0  0   15.9 16.5 17.0 17.7 18.2 18.3 18.6 19.0 19.3 19.8
61  9  129   1  1  1   21 21 22    0  3  0  0  0  0 30  0  0  0   24.4 25.1 26.0 26.7 27.2 27.9 28.3 29.0 29.2 30.4
61  9  130   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.0  4.6  5.1  6.8

61  9  131   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.1  5.0  6.6
61  9  132   1  1  1   10 10 20    0  0  0  0  0  0  0  0  0  0    4.5  6.0  7.6  9.3 10.5 11.9 12.8 13.8 14.9 16.7
61  9  133   1  1  1   10 11 11    0  0  0  0  0  0  0  0  0  0    4.9  5.7  6.6  7.4  8.2  8.9  9.5 10.1 10.9 12.0
61  9  134   1  1  1   11 13 13    0  0  0  0  0  0  0  0  0  0     .0  4.2  4.9  5.3  5.8  6.0  6.2  6.4  6.7  7.1
61  9  135   1  1  1   10 12 22    0  0  0  0  0  0  0  0  0  0    7.0  7.8  8.8  9.6 10.2 10.8 11.0 11.5 11.8 12.3
61  9  136   1  1  1   10 10 21    0  0  0  0  0  0  0  0  0  3    5.0  6.2  7.5  8.7  9.7 10.5 11.2 12.1 12.8 13.8
61  9  137   1  1  1   1X 11 11    0  0  0  0  0  0  0  0  0  0     .0   .0  4.3  4.9  5.6  6.2  6.9  7.5  8.1  9.4
61  9  138   1  1  1   21 23 23    0  0  0  0  0  0  0  0  0 62   20.3 20.9 21.6 22.1 22.6 22.9 23.0 23.4 23.6 24.0
61  9  139   2  2  2   32 33 32    0 65 [illegible]  3  0  0 30  0  0  0   30.3 30.7 31.0 31.6 31.9 32.2 32.3 32.4 32.8 33.3
61  9  140   2  2  2   42 44 44    0 64  0  0  0  0  0  0  0 98   33.4 33.8 34.1 34.5 34.9 34.9 35.0 35.0 35.3 35.3

61  9  141   2  2  2   32 33 34    0  3  0  0  0  0 30  0  0  0   42.4 42.8 43.3 43.7 44.0 44.3 44.3 44.6 44.6 44.8
61  9  142   1  1  1   1X 1X 10    0  0  0  0  0  0 40  0  0  0     .0   .0   .0   .0   .0   .0  3.9  5.1  6.0  7.6
61  9  143   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.5
61  9  144   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.1  4.9  6.2
61  9  145   1  1  1   11 11 11    0  0  0  0  0  0  0  0  0  0     .0  4.2  4.8  5.4  6.0  6.6  7.2  7.8  8.5  9.6
61  9  146   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  3.7  4.5  6.1
61  9  147   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0  4.0  6.3
61  9  148   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0  4.1  6.0
61  9  149   1  1  1   10 11 21    0  0  0  0  0 14  0  0  0  0    5.6  5.8  8.2  9.5 10.5 11.1 11.6 12.4 13.0 14.0
61  9  150   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0 14     .0   .0   .0   .0   .0  4.0  4.6  5.3  6.0  7.3

61  9  151   1  1  1   1X 12 12    0  0  0  0  0  0  0  0  0  0     .0   .0   .0  4.0  4.3  4.6  4.9  5.3  5.6  6.1
61  9  152   1  1  1   10 21 22    0  0  0  0  0  0  0  0  0  0    [illegible].2  9.4 11.0 11.9 12.9 13.6 14.0 14.6 15.3 16.0
61  9  153   1  1  1   10 11 22    0  0  0  0  0  0  0  0  0  0    6.7  7.9  9.3 10.5 11.4 12.1 12.7 13.4 14.0 14.7
61  9  154   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  3.9  4.5  6.0
61  9  155   1  1  1   10 11 12    0  0  0  0  0 14  0  0  0  0    3.8  4.8  6.0  7.0  7.7  8.5  9.0  9.7 10.2 11.0
61  9  156   1  1  1   10 10 22    0  0  0  0  0  0  0  0  0  0    5.9  7.0  8.6  9.5 10.2 10.9 11.6 12.3 12.8 13.5
61  9  157   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.3  5.1  6.0  7.6
61  9  158   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0  3.7  4.4  5.3  6.1  7.7
61  9  159   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0  4.2  5.1  5.9  6.5  8.0
61  9  160   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.6  4.3  5.8  8.1

61  9  161   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.7  6.0  5.9  8.3
61  9  162   1  1  1   12 13 13    0  0  0  0  0  0  0  0  0  0    4.5  4.7  5.0  5.3  5.5  5.7  5.8  6.1  6.3  6.7
61  9  163   1  1  1   11 10 10    0  0  0  0  0  0  0  0  0  0     .0  3.8  4.5  5.2  5.9  6.6  7.3  8.0  8.8 10.1
61  9  164   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.2  4.9  6.4
61  9  165   1  1  1   11 11 12    0  0  0  0  0  0  0  0  0 14    4.2  4.7  5.2  5.7  6.2  6.7  7.2  7.7  8.3  9.1
61  9  166   1  1  1   11 11 11    0  0  0  0  0  0  0  0  0  0    4.5  5.0  5.5  6.0  6.5  7.0  7.5  8.0  8.4  9.5
61  9  167   1  1  1   1X 11 13    0  0  0  0  0 33  0  0  0  0     .0   .0  3.8  5.6  6.4  7.1  7.8  8.1  8.4  8.6
61  9  168   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0 14     .0   .0   .0   .0   .0   .0   .0   .0  4.2  6.7
61  9  169   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  3.9  4.3  6.2
61  9  170   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.9  4.3  4.9  6.7

61  9  171   1  1  1   10 21 22    0  0  0  0  0  0  0  0  0  3    7.2  8.5 10.2 11.5 12.3 13.2 13.7 14.4 14.8 15.5
61  9  172   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.2  4.7  5.2  6.4
61  9  173   1  1  1   1X 10 10    0  0  0  0  0  0  0  0  0  0     .0   .0  3.9  4.5  5.3  6.0  6.8  7.5  8.2  9.9
61  9  174   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0  3.9  4.6  5.3  6.0  7.6
61  9  175   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0 33     .0  3.8  4.8  5.8  7.2  8.0  8.7  9.2  9.8 10.5
61  9  176   1  1  1   10 12 13    0  0  0  0  0  0  0  0  0  2     .0  3.8  5.2  6.2  7.1  7.5  7.9  8.2  8.4  8.6
61  9  177   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  3     .0  4.0  4.3  4.7  4.9  5.3  5.7  6.0  6.3  6.8
61  9  178   1  1  1   1X 12 12    0  0  0  0  0  0  0  0  0  3     .0   .0  4.0  4.3  4.7  5.1  5.6  6.0  6.2  6.9
61  9  179   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.1  4.6  6.1
61  9  180   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0 33     .0   .0   .0   .0   .0   .0   .0  4.0  4.8  6.0

61  9  181   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0    4.6  5.0  5.3  5.7  6.1  6.4  6.8  7.2  7.6  8.3
61  9  182   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.2  5.0  5.8  6.6
61  9  183   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.1  5.1  6.0  7.2
61  9  184   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0  7.9  8.5
61  9  185   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0  4.5  7.0
61  9  186   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.9
61  9  187   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.3  5.1  6.8
61  9  188   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  [illegible].6  4.6  6.1
61  9  189   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0 33     .0   .0   .0   .0   .0   .0  4.3  5.1  6.0  7.6
61  9  190   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0     .0   .0  4.3  5.7  6.8  7.9  8.5  9.3  9.9 10.9
```

61	9	191	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.7	4.4	5.1	6.8
61	9	192	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.3	5.1	6.0	7.5
61	9	193	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	.0	.0	4.0	4.9	5.9	7.6
61	9	194	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.0	6.7
61	9	195	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.3	5.0	5.8	6.6	8.4
61	9	196	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.9	4.6	5.2	6.0	7.8
61	9	197	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.0	5.7	6.4	8.1
61	9	198	1	1	1	13	12	13	0	0	0	0	0	0	0	0	0	3	4.8	5.1	5.3	5.7	5.9	6.2	6.5	6.8	7.1	7.5
61	9	199	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.5	6.0	8.0
61	9	200	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.7	5.3	6.5	7.6	8.5	9.3	10.5
61	9	201	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.8	5.5	7.1
61	9	202	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.6	4.4	5.2	6.0	7.2	8.2	9.1
61	9	203	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.3	5.0	5.8	6.5	8.0
61	9	204	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	3.9	4.6	5.4	6.2	7.0	8.5
61	9	205	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.7	4.4	5.0	6.6
61	9	206	1	1	1	22	24	24	0	0	0	0	0	0	30	0	0	0	20.3	20.6	20.9	21.2	21.6	21.9	21.9	22.0	22.3	22.3
61	9	207	1	1	1	22	22	23	0	0	0	0	0	0	30	0	0	0	20.2	20.7	20.9	21.4	22.0	22.3	22.7	22.9	23.2	23.6
61	9	208	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.2	7.2
61	9	209	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.8	4.4	5.1	6.0	6.9
61	9	210	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.1	6.3
61	9	211	1	1	1	23	24	24	0	0	0	0	0	0	0	0	0	0	13.8	14.0	14.2	14.3	14.5	14.5	14.5	14.6	14.6	14.6
61	9	212	1	1	1	20	21	20	0	4	0	0	0	0	0	0	0	0	27.2	28.0	28.9	29.6	30.3	30.8	31.3	31.8	33.1	35.6
61	9	213	1	1	1	24	24	24	0	0	0	0	0	0	0	0	24	24	17.4	17.4	17.4	17.5	17.5	17.6	17.8	17.9	18.0	18.1
61	9	214	1	1	1	21	22	22	0	0	0	0	0	0	0	0	30	0	20.3	20.9	21.7	22.1	22.6	23.2	23.4	23.9	24.5	25.1
61	9	215	1	1	1	23	24	24	0	0	0	0	0	0	30	30	30	3	17.9	18.1	18.3	18.5	18.7	18.7	18.7	18.7	18.8	18.8
61	9	216	1	1	1	22	23	24	0	0	0	0	0	0	30	0	30	0	19.2	19.6	19.9	20.3	20.7	20.9	21.1	21.1	21.3	21.5
61	9	217	1	1	1	21	22	22	0	0	0	0	0	0	30	30	30	0	19.0	19.5	19.8	20.5	21.1	21.4	21.7	22.1	22.6	23.1
61	9	218	1	1	1	22	22	24	0	0	0	0	0	0	42	43	42	0	22.6	23.0	23.4	23.8	24.2	24.6	25.0	25.2	25.3	25.4
61	9	219	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.3	5.1	6.0	7.3
61	9	220	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	4.1	4.8	6.4
61	9	221	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.9	5.2	7.7
61	9	222	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	3.8	4.4	5.0	6.2
61	9	223	1	1	1	1X	13	12	0	0	0	0	0	0	0	0	0	2	.0	.0	.0	4.2	4.6	4.9	5.2	5.3	5.7	6.1
61	9	224	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	4.3	5.0	6.8
61	9	225	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.3	6.8
61	9	226	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.0	6.0	8.2
61	9	227	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	3.6	4.3	5.2	6.0	7.2
61	9	228	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	3.8	4.5	6.0
61	9	229	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	3.9	4.6	6.1
61	9	230	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	3.6	4.3	6.0
61	9	231	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	2	.0	.0	.0	.0	.0	.0	.0	3.7	5.0	7.5
61	9	232	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.1	6.6
61	9	233	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.6	5.3	6.7
61	9	234	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	4.0	4.5	6.0
61	9	235	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	4.0	4.6	5.0	6.4
61	9	236	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.7	4.5	6.8
61	9	237	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	4.3	5.1	6.0	7.5
61	9	238	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	4.0	4.7	5.4	7.0
61	9	239	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	3.8	4.5	6.2
61	9	240	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	4.7	5.2	7.7
61	9	241	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	5.1	6.0	6.9	7.6	8.0
61	9	242	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	51	.0	.0	.0	.0	4.0	5.0	5.8	6.7	7.5	8.1
61	9	243	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.0	7.5
61	9	244	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.7	6.3
61	9	245	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	4.0	5.2	7.8
61	9	246	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	3.9	5.0	7.1
61	9	247	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	5.7	7.6	8.4	9.1	10.0	10.6	11.7
61	9	248	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.8
61	9	249	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	.0	4.2	4.7	5.2	5.7	6.2	6.7	7.2	7.7	8.7
61	9	250	2	2	2	4X	4X	4X	0	0	90	0	0	0	0	0	0	0	29.1	29.1	29.1	.0	.0	.0	.0	.0	.0	.0
61	9	251	2	2	2	44	44	4X	0	0	52	0	0	0	52	92	0	0	31.2	31.3	31.5	31.5	31.7	31.7	31.7	32.0	.0	.0
61	9	252	2	2	2	44	4X	4X	0	64	52	9	0	0	92	0	0	0	27.0	27.1	27.1	27.1	27.2	27.2	27.3	.0	.0	.0
61	9	253	1	1	1	14	1X	1X	0	33	2	0	0	4	95	0	0	0	5.2	5.3	5.4	5.5	5.5	5.5	5.6	.0	.0	.0
61	9	254	1	1	1	12	1X	1X	0	13	0	0	91	0	0	0	0	0	4.9	5.3	6.0	6.2	6.2	.0	.0	.0	.0	.0
61	9	255	2	2	2	43	44	44	0	0	52	9	0	13	30	0	0	98	26.0	26.2	26.6	26.6	26.7	26.9	26.9	26.9	27.0	27.0
61	9	256	2	2	2	44	44	44	0	64	52	0	0	0	0	0	0	92	37.4	37.5	37.5	37.6	37.8	37.8	37.8	37.8	37.9	38.2
61	9	257	1	1	1	23	24	24	0	3	0	0	0	0	30	0	0	92	13.9	14.1	14.3	14.5	14.6	14.8	14.8	14.8	14.9	14.9

TABLE 1.10:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE- VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	10	1	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	1	1	.0	.0	.0	.0	.0	4.0	4.6	5.3	6.0	7.7
61	10	2	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.4	6.3	7.5	8.1	8.9	9.8	10.7	11.6
61	10	3	1	1	1	10	21	23	0	0	0	0	0	0	0	0	0	0	8.9	10.0	11.4	12.8	13.2	13.7	14.2	14.7	15.0	15.4
61	10	4	1	1	1	20	20	21	0	0	0	0	0	0	0	0	0	0	10.6	11.7	13.2	14.1	15.0	16.0	16.6	17.1	17.8	18.6
61	10	5	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	3	4.7	5.8	7.2	8.2	9.0	9.7	10.3	10.8	11.4	12.2
61	10	6	1	1	1	12	12	13	0	0	0	0	0	0	0	0	0	0	4.5	5.0	5.5	6.0	6.4	7.0	7.2	7.4	7.6	7.8
61	10	7	1	1	1	1X	11	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	5.2	6.0	6.8	7.4	7.8	8.2	9.0
61	10	8	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	5.0	6.5
61	10	9	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	6.6
61	10	10	2	2	2	42	43	43	0	0	52	0	0	0	0	0	60	0	32.8	32.8	33.2	33.6	33.9	34.2	34.3	34.4	34.8	34.8
61	10	11	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	10	12	1	1	1	21	23	23	0	0	34	0	0	0	32	32	0	0	21.2	21.8	22.6	23.0	23.6	23.7	24.1	24.3	24.5	24.8
61	10	13	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.7	5.4	6.1	7.3
61	10	14	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.4
61	10	15	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	5.7	6.7	7.6	8.1	8.9	9.6	10.5
61	10	16	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	5.0	5.8	6.5	7.3	7.8	8.3	9.5
61	10	17	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.6	4.4	5.2	6.0	6.8	8.3
61	10	18	2	2	2	33	34	33	0	0	0	0	0	0	0	0	0	0	27.4	27.6	27.7	28.0	28.1	28.3	28.4	28.5	28.7	29.1
61	10	19	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.8
61	10	20	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.3	5.0	5.7	6.3	7.0	8.3

```
61  10   21    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  5.0  7.1
61  10   22    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.9  4.8  6.8
61  10   23    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.8  6.0
61  10   24    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.3
61  10   25    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.9  6.4
61  10   26    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  3.7  4.5  5.3  6.8
61  10   27    1  1  1    20 21 22     0  0  0  0  0  0  0  0  0  3     7.9  9.0 10.3 11.3 12.2 12.9 13.4 14.0 14.6 15.3
61  10   28    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.2  5.0  5.8  6.7  8.3
61  10   29    1  1  1    1X 1X 1X     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.3  6.8
61  10   30    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  4.8  6.2

61  10   31    1  1  1    1X 1X 1X     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.2  6.2
61  10   32    1  1  1    10 10 10     0  0  0  0  0  0  0  0  0  0      .0  4.0  4.7  5.4  6.2  6.9  7.6  8.4  9.3 10.6
61  10   33    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.3  5.0  5.7  7.2
61  10   34    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0 14      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.3
61  10   35    1  1  1    1X 12 13     0  0  0  0  0  0  0  0  0  0      .0   .0   .0  4.2  4.6  5.0  5.3  5.6  5.8  6.3
61  10   36    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.3
61  10   37    1  1  1    1X 12 12     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.1  4.6  5.0  5.4  5.8  6.3
61  10   38    1  1  1    11 11 11     0  0  0  0  0  0  0  0  0  0      .0  4.0  4.6  5.3  6.0  6.6  7.3  8.0  8.9 10.0
61  10   39    1  1  1    10 22 22     0  2  0  0  0  0  0  0  0  0    10.2 11.3 12.6 13.4 14.1 14.5 14.9 15.4 15.7 16.6
61  10   40    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.5  5.1  7.2

61  10   41    1  1  1    10 12 12     0 33  0  0  0  0  0  0  0  3     5.3  6.4  7.8  8.9  9.7 10.3 10.6 11.0 11.5 12.2
61  10   42    1  1  1    10 11 12     0  0  0  0  0  0  0  0  0  0     3.9  5.0  6.4  7.0  8.3  8.8  9.3 10.0 10.6 11.4
61  10   43    1  1  1    10 12 12     0  0  0  0  0  0  0  0  0  3     5.1  6.0  7.1  7.9  8.6  9.0  9.3  9.8 10.2 10.7
61  10   44    1  1  1    10 22 22     0  0  0  0  0  0  0  0  0  0     6.1  7.7 10.9 11.7 12.4 13.0 13.3 13.8 14.2 14.8
61  10   45    1  1  1    10 12 22     0  0  0  0  0  0  0  0  0  0     7.9  8.8 10.1 10.8 11.5 11.7 12.2 12.7 13.2 13.8
61  10   46    1  1  1    10 11 12     0  0  0  0  0  0 34  0  0  3      .0  3.9  4.8  5.9  6.7  7.4  7.9  8.2  8.8  9.5
61  10   47    1  1  1    10 21 21     0  0  0  0  0  0  0  0  0  0     8.4  9.3 10.5 11.4 12.1 12.9 13.5 14.2 14.9 15.9
61  10   48    1  1  1    10 22 22     0  0  0  0  0  0  0  0  0  3     9.6 10.7 11.8 12.9 13.9 14.3 14.8 15.3 15.9 16.7
61  10   49    1  1  1    10 22 22     0  3  0  0  0  0  0  0  0  0     9.7 10.4 11.3 12.0 12.6 13.0 13.2 13.6 14.0 14.6
61  10   50    1  1  1    11 12 12     0  0  0  0  0  0  0  0  0  3     4.6  5.3  6.0  6.6  7.3  7.6  8.0  8.2  8.5  9.0

61  10   51    1  1  1    10 12 12     0  0  0  0  0  0  0  0  0  0     4.3  5.1  6.2  6.8  7.5  7.7  8.0  8.3  8.7  9.3
61  10   52    1  1  1    10 22 23     0  0  0  0  0  0  0  0  0  0     8.7  9.5 10.6 11.3 11.9 12.3 12.6 13.1 13.4 13.9
61  10   53    1  1  1    10 21 22     0  0  0  0  0  0  0  0  0  0     8.8  9.6 10.6 11.4 12.1 12.7 13.1 13.8 14.0 14.8
61  10   54    1  1  1    11 13 13     0  0  0  0  0  0  0  0  0  0     7.8  8.4  9.2  9.6 10.1 10.4 10.5 10.8 11.0 11.3
61  10   55    1  1  1    10 11 22     0  2  0  0  0  0  0  0  0  0     6.1  7.1  8.2  9.1 10.1 10.7 11.1 11.6 12.1 12.9
61  10   56    1  1  1    12 13 13     0  0  0  0  0  0  0  0  0  0     4.9  5.3  5.6  6.1  6.5  6.8  7.0  7.2  7.4  7.7
61  10   57    1  1  1    10 21 21     0 33  0  0  0  0  0  0  0  0     7.8  9.0 10.3 11.3 12.5 13.1 13.8 14.5 15.4 16.4
61  10   58    1  1  1    10 21 21     0  0  0  0  0  0  0  0  0  0     9.4 10.4 11.4 12.5 13.3 13.7 14.2 14.8 15.6 16.4
61  10   59    1  1  1    10 11 11     0  0  0  0  0  0  0  0  0  0      .0  4.4  5.7  6.8  7.6  8.2  8.8  9.5 10.1 11.1
61  10   60    1  1  1    10 21 21     0  0  0  0  0  0  0  0  0  0     8.2  9.2 10.4 11.4 12.3 12.9 13.6 14.3 14.9 16.0

61  10   61    1  1  1    11 11 11     0  0  0  0  0  0  0  0  0  0      .0  3.8  4.4  5.1  5.8  6.4  7.1  7.8  8.4  9.8
61  10   62    1  1  1    10 10 11     0  0  0  0  0  0  0  0  0  0      .0  3.6  5.4  6.7  8.0  8.5  9.4 10.2 10.9 11.9
61  10   63    1  1  1    10 11 12     0  0  0  0  0  0  0  0  0  3     4.4  5.5  6.8  7.9  8.9  9.5 10.1 10.8 11.4 12.1
61  10   64    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.2  7.8
61  10   65    1  1  1    11 12 23     0  0  0  0  0  0  0  0  0  3     7.8  8.5  9.2 10.0 10.5 10.9 11.2 11.6 11.9 12.3
61  10   66    1  1  1    10 11 22     0  0  0  0  0  0  0  0  0  3     8.2  9.0  9.9 10.7 11.5 12.0 12.4 13.0 13.5 14.3
61  10   67    1  1  1    10 12 12     0 33  2  0  0  0  0  0  0  3     5.4  6.2  7.0  7.7  8.4  8.8  9.2  9.7 10.3 11.0
61  10   68    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0 35      .0   .0   .0   .0   .0   .0   .0  3.8  5.0  6.8
61  10   69    1  1  1    1X 10 10     0  0  0  0  0  0  0  0  0 35      .0   .0   .0   .0  3.7  4.8  5.8  6.3  7.0  8.7
61  10   70    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  5.0  7.4

61  10   71    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.9  5.1  7.3
61  10   72    2  2  2    32 33 34     0  0  0  0  0  0  0  0  0  0    28.4 28.8 29.3 29.7 30.0 30.3 30.3 30.5 30.5 30.8
61  10   73    2  2  2    33 34 32     0  0  0  0  0  0  0  0  0 52    31.3 31.5 31.8 31.9 32.0 32.2 32.2 32.3 32.5 33.1
61  10   74    1  1  1    22 22 22     0  0  0  0  0  0  0  0  0  0    16.5 16.9 17.4 17.8 18.2 18.6 18.9 19.2 19.6 20.4
61  10   75    1  1  1    23 24 24     0  0  0  0  0  0  0  0  0  0    21.1 21.3 21.4 21.7 22.0 22.0 22.1 22.1 22.1 22.1
61  10   76    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  3.7  4.8  5.9  8.1
61  10   77    1  1  1    1X 1X 1X     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.2  6.4
61  10   78    1  2  2    32 33 32     0  0  0  0  0  0  0  0  0  3    32.0 32.3 32.5 32.8 33.1 33.4 33.6 33.8 34.1 34.8
61  10   79    2  2  2    42 43 43     0 62  0  0  0  0  0  0  0  0    19.0 19.3 19.6 19.9 20.1 20.4 20.6 20.7 20.9 21.4
61  10   80    1  1  1    10 10 21     0  0  0  0  0  0  0  0  0  0     4.5  5.4  6.8  8.0  9.2 10.0 10.7 11.3 12.1 13.1

61  10   81    1  1  1    10 11 22     0  0  0  0  0  0  0  0  0  3     6.9  7.9  9.0  9.8 10.8 11.5 11.9 12.5 13.1 13.8
61  10   82    1  1  1    11 12 12     0  0  0  0  0  0  0  0  0  0     4.4  5.1  5.9  6.5  7.1  7.5  7.9  8.2  8.6  9.1
61  10   83    1  1  1    10 13 12     0  0  0  0  0  0  0  0  0  3     5.1  6.3  7.4  8.1  9.8  9.4  9.8 10.3 10.8 11.5
61  10   84    1  1  1    10 12 12     0  0  0  0  0  0  0  0  0  0     4.8  6.0  7.3  8.1  9.7  9.7 10.1 10.6 11.2 12.0
61  10   85    1  1  1    10 20 21     0  0  0  0  0  0  0  0  0  0     8.4  9.6 10.9 12.1 13.3 14.2 14.9 15.6 16.3 17.1
61  10   86    1  1  1    1X 12 13     0  0  0  0  0  0  0  0  0  0      .0   .0  4.2  4.7  5.2  5.7  5.9  6.1  6.3  6.8
61  10   87    1  1  1    1X 1X 1X     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.1  6.4
61  10   88    2  2  2    32 32 32     0  5  0  0  0  0  0  0  0  0    19.9 20.4 21.0 21.3 21.8 22.3 22.7 23.2 23.4 24.0
61  10   89    2  2  2    32 32 32     0  0  0  0  0  0  0  0  0  0    26.5 26.8 27.1 27.4 27.8 28.1 28.3 28.6 28.8 29.6
61  10   90    2  2  2    32 33 33     0  0  0  0  0  0  0  0  0  0    25.7 26.0 26.1 26.6 26.8 27.0 27.1 27.3 27.4 27.8

61  10   91    2  2  2    33 33 33     0  0  0  0  0  0  0  0  0  0    26.2 26.4 26.7 26.8 27.1 27.4 27.5 27.6 27.8 28.2
61  10   92    1  1  1    10 11 12     0  0  0  0  0  0  0  0  0  0     4.6  5.6  6.8  7.7  8.5  9.5 10.0 10.5 11.0 11.7
61  10   93    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.9  6.2
61  10   94    1  1  1    10 12 22     0  0  0  0  0  0  0  0  0  0     4.2  5.0  6.0  6.6  7.4  7.8  8.2  8.5  9.1  9.6
61  10   95    1  1  1    10 21 23     0 33  0  0  0  0  0  0  0  3     8.8  9.5 10.5 11.1 11.7 12.3 12.7 13.2 13.5 13.9
61  10   96    1  1  1    10 11 22     0  0  0  0  0  0  0  0  0  0     7.9  8.6  9.5 10.2 10.8 11.4 11.9 12.4 12.9 13.3
61  10   97    1  1  1    12 12 14     0  0  0  0  0  0  0  0  0  0      .0  3.7  4.0  4.2  4.6  5.0  5.0  5.6  5.7  6.0
61  10   98    1  1  1    10 11 22     0  0  0  0  0  0  0  0  0  0     7.2  7.9  9.1  9.8 10.7 11.3 11.8 12.5 13.1 13.9
61  10   99    1  1  1    10 10 21     0  0  0  0  0  0  0  0  0  0     3.8  5.2  7.0  8.3  9.3 10.2 10.9 11.8 12.4 13.3
61  10  100    1  1  1    12 12 12     0  0  0  0  0  0  0  0  0  0     5.5  5.9  6.2  6.6  7.0  7.3  7.7  8.1  8.4  9.2

61  10  101    1  1  1    1X 12 13     0  0  0  0  0  0  0  0  0  0      .0   .0   .0  4.0  4.3  4.7  5.1  5.4  5.6  6.0
61  10  102    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.0  4.7  5.5  6.3  8.0
61  10  103    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  2      .0   .0   .0   .0   .0  4.2  4.8  5.7  6.4  7.9
61  10  104    1  1  1    1X 11 13     0  0 33  0  0  0  0  0  0  0      .0   .0  3.8  5.0  5.8  6.6  7.0  7.4  7.7  8.0
61  10  105    1  1  1    1X 10 11     0  0  0  0  0  0  0  0  0  0      .0   .0  4.3  5.5  6.5  7.5  8.0  8.7  9.4 10.3
61  10  106    1  1  1    10 20 21     0 35  2  0  0  0  0  0  0  3     6.6  8.3 10.4 11.8 13.3 14.5 15.1 15.7 16.3 17.4
61  10  107    1  1  1    10 11 12     0  0  0  0  0  0  0  0  0  0      .0  4.1  4.9  5.8  6.6  7.4  7.8  8.4  8.8  9.6
61  10  108    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  3.9  4.6  5.3  6.9
61  10  109    1  1  1    10 11 11     0  0  0  0  0  0  0  0  0  0      .0  4.0  5.4  6.5  7.6  8.4  9.1  9.7 10.2 11.2
61  10  110    1  1  1    1X 10 10     0  0  0  0  0  0  0  0  0  0      .0   .0  4.3  5.6  6.6  7.6  8.2  8.8  9.7 11.0

61  10  111    1  1  1    12 12 12     0  0  0  0  0  0  0  0  0  0     5.0  5.3  5.6  5.9  6.2  6.6  7.0  7.4  7.8  8.4
61  10  112    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.6  6.2
61  10  113    1  1  1    10 11 13     0  0  0  0  0  0  0  0  0  0     5.2  6.2  7.5  8.5  9.2  9.9 10.3 10.8 11.1 11.5
61  10  114    1  1  1    11 11 11     0  0  0  0  0  0  0  0  0  0     4.1  4.6  5.1  5.6  6.1  6.6  7.1  7.6  8.1  9.1
61  10  115    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.2  5.0  5.7  6.4  8.0
61  10  116    1  1  1    10 21 21     0 33  0  0  0  0 30  0  0 52     8.4  9.7 11.3 12.4 13.6 14.5 14.9 15.5 16.1 17.2
61  10  117    2  2  2    42 43 42     0  0 42  0  0  0  0  0  0  0    30.0 30.3 30.7 30.9 31.3 31.6 31.7 31.8 32.1 32.6
61  10  118    1  1  1    10 21 22     0 33  3  0  0  0  0  0  0  0     7.6  8.8 10.1 11.1 12.2 13.0 13.5 14.1 14.6 15.3
61  10  119    1  1  1    12 13 14     0  0  0  0  0  0  0  0  0  9     5.4  5.7  6.0  6.3  6.5  6.7  6.9  7.1  7.3  7.5
61  10  120    1  1  1    10 20 20     0  0  0  0  0  0  0  0  0  0     8.2  9.5 11.3 12.4 13.5 14.4 15.2 15.9 16.7 18.1
```

61	10	121	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	0	4.2	4.3	4.5	4.7	5.0	5.3	5.5	5.7	5.9	6.3
61	10	122	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.3
61	10	123	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.9	4.6	5.3	6.0	6.8	8.2
61	10	124	1	1	1	10	10	11	0	0	0	0	0	0	0	0	0	0	.0	4.0	5.2	6.6	7.7	8.7	9.2	9.9	10.6	11.6
61	10	125	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.6
61	10	126	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	0	3.9	5.4	7.4	8.8	9.8	10.7	11.5	12.0	12.7	13.5
61	10	127	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	4.3	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.3	9.3
61	10	128	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	4.6	5.3	7.1
61	10	129	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.5
61	10	130	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	1	.0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.1
61	10	131	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	5.0	5.7	6.3	7.0	7.6	8.3	9.3
61	10	132	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	3	.0	.0	4.0	4.8	5.4	6.2	7.0	7.8	8.2	8.7
61	10	133	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	5.5	6.5	7.6	7.9	8.5	9.2	10.0
61	10	134	1	1	1	1X	10	13	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.9	6.5	7.3	7.6	8.0
61	10	135	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	.0	3.9	4.7	6.0
61	10	136	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.0	7.6
61	10	137	1	1	1	11	12	22	0	0	14	0	0	0	0	0	0	0	9.0	9.6	10.4	11.0	11.6	12.0	12.3	12.6	13.0	13.5
61	10	138	1	1	1	20	21	22	0	0	0	3	0	0	0	0	0	0	11.2	12.3	13.7	14.6	15.6	16.3	17.0	17.6	18.1	19.0
61	10	139	1	1	1	10	11	11	0	2	0	0	0	0	0	0	0	0	4.9	5.7	6.6	7.2	8.1	8.8	9.5	10.0	10.7	11.6
61	10	140	1	1	1	10	13	13	0	0	0	0	0	0	0	0	0	52	6.2	7.0	8.1	8.8	9.3	9.6	9.8	10.0	10.3	10.7
61	10	141	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	.0	4.0	4.6	5.2	5.8	6.4	7.0	7.6	8.3	9.4
61	10	142	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	2	.0	.0	.0	.0	.0	.0	.0	4.2	4.9	6.3
61	10	143	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.3	5.0	6.4
61	10	144	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.1	4.8	5.4	6.0	7.2
61	10	145	1	1	1	10	10	12	0	0	0	0	0	0	0	0	0	0	.0	3.5	4.8	6.4	7.7	8.7	9.2	9.9	10.5	11.3
61	10	146	1	1	1	10	10	12	0	0	0	0	0	0	0	0	0	3	.0	3.7	5.1	6.8	8.2	8.9	9.7	10.9	11.0	12.2
61	10	147	1	1	1	1X	11	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.8	5.1	6.1	6.1	7.0	7.8	8.2
61	10	148	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.5
61	10	149	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.9	6.4
61	10	150	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	5.2	6.4	7.3	7.9	8.5	9.1	10.1
61	10	151	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.9	4.6	5.2	5.9	7.3
61	10	152	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	2	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.5
61	10	153	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	5.1	6.3	7.4	8.0	8.6	9.4	10.4
61	10	154	1	1	1	1X	10	13	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.8	4.8	5.5	5.8	6.1	6.4	6.9
61	10	155	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	5.2	6.6	7.4	8.0	8.6	9.4	10.7
61	10	156	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.1	5.0	5.7	6.5	8.0
61	10	157	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.8	4.6	5.1	6.7
61	10	158	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.1	7.7
61	10	159	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.7	4.9	7.4
61	10	160	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.3
61	10	161	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.8
61	10	162	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	.0	.0	4.2	5.0	5.8	7.4
61	10	163	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	.0	3.5	4.6	6.0	7.2	8.0	8.6	9.2	9.9	10.8
61	10	164	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.3	5.0	6.3
61	10	165	1	1	1	10	10	21	0	33	0	0	0	0	0	0	0	0	4.8	6.5	8.4	10.1	11.5	12.5	13.3	14.1	14.7	16.0
61	10	166	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.1	4.7	5.3	6.0	7.2
61	10	167	2	2	2	42	43	43	0	5	0	0	0	0	0	0	0	0	17.9	18.2	18.5	18.9	19.2	19.3	19.4	19.7	19.7	20.1
61	10	168	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.8	5.8	6.8	7.4	7.9	8.6	9.2	10.0
61	10	169	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	4.6	5.6	6.8	7.8	8.6	9.2	9.6	10.2	10.7	11.3
61	10	170	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.6	5.8	6.8	7.7	8.2	8.9	9.4	10.1
61	10	171	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	1	4.1	4.4	4.7	5.0	5.2	5.4	5.6	5.8	6.0	6.4
61	10	172	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.2
61	10	173	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	3.9	4.6	5.3	6.1	6.8	7.6	8.3	9.8
61	10	174	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.8	4.8	5.7	6.7	7.7	8.7	10.6
61	10	175	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.5	5.8	6.1	6.4	6.7	7.0	7.3	7.6	7.9	8.5
61	10	176	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.3	5.6	5.9	6.2	6.5	6.8	7.1	7.4	7.7	8.3
61	10	177	1	1	1	1X	11	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	5.6	6.5	7.3	7.7	8.4	8.9	9.8
61	10	178	1	1	1	1X	13	13	0	0	0	0	0	0	0	0	0	33	.0	.0	3.7	4.5	5.1	5.6	5.6	5.9	6.2	6.6
61	10	179	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	4.4	5.4	6.5	7.5	8.3	8.8	9.3	9.8	10.3	10.9
61	10	180	1	1	1	10	20	21	0	0	0	0	0	0	0	0	0	0	8.0	9.2	10.6	11.9	12.9	13.6	14.2	15.0	15.7	16.6
61	10	181	1	1	1	11	13	13	0	33	0	0	0	0	0	0	0	0	4.4	5.1	5.9	6.6	7.2	7.4	7.6	7.9	8.1	8.5
61	10	182	1	1	1	10	21	22	0	33	3	0	0	0	0	0	0	0	7.8	8.9	10.1	11.3	12.3	12.9	13.5	14.1	14.7	15.4
61	10	183	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	4.2	4.7	5.3	5.8	6.4	6.9	7.4	8.0	8.6	9.6
61	10	184	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.7	6.1
61	10	185	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.3
61	10	186	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	4.9	5.9	7.0	7.9	8.8	9.4	10.0	10.4	10.8	11.8
61	10	187	1	1	1	10	12	22	0	0	3	0	0	0	0	0	0	52	7.3	8.3	9.6	10.3	11.3	11.9	12.2	12.7	13.2	13.7
61	10	188	1	1	1	10	12	22	0	0	0	0	0	0	0	0	0	52	8.5	9.2	10.0	10.7	11.4	11.8	12.1	12.6	13.1	13.6
61	10	189	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	0	6.3	6.6	7.0	7.3	7.6	7.8	7.9	8.1	8.2	8.6
61	10	190	1	1	1	11	12	23	0	0	0	0	0	0	0	0	0	0	8.4	9.1	10.0	10.5	11.1	11.6	12.0	12.4	12.7	13.0
61	10	191	1	1	1	13	13	14	0	0	0	0	0	0	0	0	0	14	6.5	5.7	5.9	6.0	6.2	6.4	6.5	6.6	6.7	6.8
61	10	192	1	1	1	12	12	13	0	0	0	0	0	0	0	0	0	0	5.9	6.4	6.9	7.3	7.8	8.1	8.3	8.6	8.8	9.1
61	10	193	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	0	3.8	4.1	4.4	4.7	5.1	5.4	5.6	5.8	6.0	6.3
61	10	194	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	3	5.4	5.7	5.9	6.2	6.4	6.5	6.7	6.9	7.1	7.5
61	10	195	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.7	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.2	8.7
61	10	196	1	1	1	12	12	11	0	0	0	0	0	0	0	0	0	30	6.4	6.9	7.5	7.9	8.3	8.6	9.0	9.2	9.5	10.9
61	10	197	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	14	6.2	6.7	7.4	7.9	8.3	8.7	9.0	9.2	9.5	10.0
61	10	198	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	3	6.9	7.4	8.1	8.6	9.0	9.5	9.8	10.1	10.5	10.9
61	10	199	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	.0	.0	4.1	5.0	5.9	7.7
61	10	200	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.5	5.8	6.1	6.4	6.7	7.0	7.3	7.6	7.9	8.5
61	10	201	1	1	1	12	13	13	0	35	9	0	0	0	0	0	0	14	4.2	4.5	4.8	5.0	5.4	5.6	5.8	5.9	6.1	6.4
61	10	202	1	1	1	10	12	23	0	35	3	0	0	0	0	0	0	0	7.9	8.6	10.1	10.1	10.8	11.0	11.3	11.7	12.0	12.3
61	10	203	1	1	1	11	12	13	0	35	0	0	0	0	0	0	0	0	5.3	5.9	6.6	7.2	7.8	8.1	8.5	8.8	9.1	9.4
61	10	204	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.4	5.6	7.9
61	10	205	1	1	1	10	10	11	0	0	0	0	0	0	0	0	0	0	.0	4.4	5.3	6.5	7.3	8.0	8.8	9.7	10.2	11.5
61	10	206	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	10	.0	.0	.0	.0	.0	.0	3.9	4.6	5.0	6.2
61	10	207	1	1	1	11	13	14	0	35	1	0	0	11	0	0	0	0	5.5	6.1	7.1	7.6	8.0	8.3	8.4	8.6	8.7	8.7
61	10	208	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	7.3	8.2	9.2	10.0	10.9	11.2	11.8	12.4	12.8	13.3
61	10	209	1	1	1	12	14	13	0	0	0	0	0	0	0	0	0	4	3.7	4.1	4.6	4.9	5.3	5.4	5.6	5.7	5.9	6.2
61	10	210	1	1	1	10	11	22	0	0	0	0	0	0	0	0	0	30	7.6	8.4	9.3	10.2	10.9	11.5	12.0	12.7	13.1	14.0
61	10	211	1	1	1	10	21	21	0	0	0	0	0	0	0	0	0	30	8.7	9.5	10.5	11.2	12.0	12.6	13.1	13.8	14.4	15.3
61	10	212	1	1	1	12	10	12	0	0	0	0	0	0	0	0	0	3	6.8	7.2	7.8	8.4	8.5	9.4	9.9	10.8	10.9	11.6
61	10	213	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	6.9	7.3	8.5	8.5	9.0	9.5	9.9	10.3	10.6	11.1
61	10	214	1	1	1	10	21	21	0	0	0	0	0	0	0	0	0	0	9.8	10.6	11.5	12.2	13.1	13.8	14.3	15.1	15.7	16.7
61	10	215	1	1	1	12	12	13	0	33	0	0	0	0	0	0	0	0	5.3	5.7	6.1	6.5	6.9	7.4	7.7	8.1	8.3	8.6
61	10	216	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	8.0	8.4	9.1	9.6	10.1	10.5	11.0	11.4	11.8	12.4
61	10	217	1	1	1	11	23	22	0	0	0	0	0	0	0	0	0	0	9.7	10.2	11.2	11.8	12.2	12.2	12.5	12.7	13.0	13.9
61	10	218	1	1	1	12	13	14	0	0	0	0	0	0	0	0	0	0	5.7	6.1	6.4	6.7	7.0	7.3	7.5	7.6	7.8	8.0
61	10	219	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	30	3.5	4.5	5.6	6.6	7.5	8.2	8.8	9.5	10.2	11.0
61	10	220	1	1	1	10	21	21	0	0	0	0	0	0	0	0	0	0	8.2	9.3	10.6	11.5	12.5	13.0	13.5	14.3	14.8	15.8

61	10	221	1	1	1	10	10	10	0	0	0	0	0	0	0	0	0	0	3.6	4.7	5.9	7.0	8.0	8.6	9.4	10.1	10.9	12.4
61	10	222	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	3	3.6	4.5	5.6	6.5	7.2	7.6	8.0	8.5	8.9	9.5
61	10	223	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	3.6	4.5	5.5	6.4	7.3	8.0	8.6	9.3	9.9	10.9
61	10	224	1	1	1	10	10	22	0	33	33	0	0	14	0	0	2	0	5.9	6.9	8.2	9.0	9.8	10.7	11.5	12.5	12.7	13.7
61	10	225	1	1	1	10	20	20	0	0	0	0	0	0	0	0	0	0	6.5	7.9	9.4	10.7	12.0	13.0	13.6	14.9	15.8	17.3
61	10	226	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	3.8	4.7	5.6	6.5	7.4	8.3	9.4	11.0
61	10	227	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	4.1	5.0	6.2	8.8
61	10	228	2	2	2	42	42	44	0	0	0	0	0	0	0	0	0	30	26.9	27.2	27.5	27.8	28.1	28.5	28.6	29.0	29.0	29.4
61	10	229	2	2	2	42	41	42	0	0	0	0	0	0	0	0	0	30	23.0	23.4	23.8	24.1	24.5	25.1	25.1	26.1	26.5	27.2
61	10	230	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	.0	4.0	5.1	7.4
61	10	231	1	1	1	10	20	21	0	0	0	0	0	0	0	0	0	0	8.7	9.8	11.0	12.2	13.1	14.2	14.9	15.8	16.5	17.8
61	10	232	1	1	1	10	20	22	0	0	0	0	0	0	0	0	0	0	7.5	8.6	10.1	11.1	12.0	12.9	13.5	14.2	14.8	15.6
61	10	233	1	1	1	10	20	20	0	0	43	0	0	0	0	0	0	0	7.1	8.3	9.7	11.0	11.8	12.7	13.6	14.4	15.1	16.5
61	10	234	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	3.8	4.6	5.3	6.0	6.4	6.7	7.1	7.8
61	10	235	1	1	1	10	10	20	0	5	0	0	0	0	0	0	0	0	4.3	5.4	6.5	7.6	8.8	9.7	10.7	12.0	13.0	14.9
61	10	236	1	1	1	10	10	20	0	5	0	0	0	0	0	0	0	0	5.9	7.0	8.2	9.2	10.2	10.9	11.6	12.4	13.1	14.5
61	10	237	1	1	1	10	10	20	0	5	0	0	0	0	0	0	0	0	5.6	6.9	8.5	9.8	10.9	11.8	12.9	14.1	15.0	16.3
61	10	238	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	3.7	4.6	5.6	6.5	7.4	8.4	9.3	11.2
61	10	239	1	1	1	22	21	22	0	33	3	0	0	0	0	30	0	0	15.0	15.5	16.1	16.5	16.9	17.4	17.8	18.4	18.9	19.8
61	10	240	1	1	1	20	20	21	0	0	0	0	0	0	0	0	0	52	15.2	16.4	18.0	19.0	20.1	21.1	21.6	22.5	23.1	24.0
61	10	241	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.9	4.6	5.2	6.9
61	10	242	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.6
61	10	243	1	1	1	10	11	21	0	0	0	0	0	0	0	0	0	0	6.1	7.1	8.2	9.2	10.1	11.0	11.5	12.1	12.7	13.6
61	10	244	1	1	1	11	13	14	0	0	0	0	0	0	0	0	0	0	4.4	4.9	5.5	6.0	6.5	6.8	7.0	7.1	7.3	7.5
61	10	245	1	1	1	10	11	21	0	0	0	0	0	0	0	0	0	0	6.4	7.3	8.3	9.1	10.1	10.9	11.4	12.0	12.6	13.6
61	10	246	1	1	1	10	11	21	0	84	0	0	0	0	0	0	0	0	7.8	8.6	9.3	10.2	11.0	11.8	12.4	13.0	13.5	14.6
61	10	247	1	1	1	11	11	12	0	84	0	0	0	0	0	0	0	0	4.6	5.2	5.6	6.2	7.0	7.6	8.0	8.6	9.2	10.0
61	10	248	1	1	1	10	21	22	0	84	0	0	0	0	0	0	0	0	10.1	11.0	12.0	12.9	13.6	14.4	14.8	15.4	15.8	16.7
61	10	249	1	1	1	10	14	14	0	73	0	0	0	0	0	0	0	14	6.0	6.7	7.7	8.3	8.8	8.9	8.9	8.9	9.0	9.1
61	10	250	1	1	1	11	12	13	0	0	33	0	0	0	0	0	0	0	3.6	4.5	5.2	5.7	6.3	6.6	6.9	7.1	7.4	7.9
61	10	251	1	1	1	10	21	21	0	0	0	0	0	0	0	0	0	0	9.5	10.7	12.5	13.0	14.2	14.8	15.2	15.9	16.7	17.6
61	10	252	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.6
61	10	253	2	2	2	42	43	43	0	0	0	0	0	0	0	0	0	0	26.2	26.5	26.9	27.2	27.5	27.7	27.9	28.1	28.3	28.7
61	10	254	2	2	2	42	44	42	0	4	0	0	0	0	0	0	0	15	13.1	13.4	13.7	14.0	14.3	14.5	14.6	14.7	15.1	15.5
61	10	255	2	2	2	30	34	34	0	0	0	0	0	0	0	0	0	0	20.3	21.6	24.9	25.2	25.5	25.6	25.7	25.9	25.9	26.2
61	10	256	2	2	2	44	44	44	0	64	9	0	0	0	0	0	30	0	16.4	16.5	16.7	16.7	16.8	16.9	16.9	16.9	16.9	17.1
61	10	257	2	2	2	42	44	44	0	0	0	0	0	0	0	0	0	9	26.9	27.2	27.5	27.8	28.1	28.2	28.3	28.4	28.4	28.5
61	10	258	2	2	2	32	33	34	0	0	0	0	0	0	0	0	0	0	21.7	22.1	22.7	23.2	23.4	23.7	23.7	23.8	23.9	24.1
61	10	259	2	2	2	32	33	33	0	0	0	0	0	0	30	0	0	52	22.2	22.5	23.0	23.4	23.9	24.2	24.2	24.5	24.6	25.1
61	10	260	2	2	2	33	34	33	0	0	0	0	0	0	0	0	0	52	22.3	22.5	22.7	22.9	23.2	23.2	23.4	23.4	23.5	23.8
61	10	261	2	2	2	32	33	34	0	0	0	0	0	0	0	0	0	0	20.4	20.8	21.3	21.5	21.9	22.1	22.2	22.3	22.3	22.5
61	10	262	2	2	2	32	33	33	0	62	0	0	0	0	0	0	0	0	28.6	28.9	29.3	29.5	29.8	30.2	30.3	30.5	30.6	31.2
61	10	263	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.8	4.6	6.0
61	10	264	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.6
61	10	265	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	5.0	6.6
61	10	266	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	4.0	5.1	6.8
61	10	267	1	1	1	1X	11	13	0	0	0	0	0	0	0	0	0	0	.0	.0	5.0	5.1	5.7	6.4	7.2	7.6	7.9	8.2
61	10	268	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.4
61	10	269	2	2	2	44	4X	4X	0	4	0	0	0	9	90	0	0	0	19.6	19.7	19.8	19.8	19.8	19.9	19.9	.0	.0	.0
61	10	270	1	1	1	13	14	1X	0	35	0	9	0	0	0	92	0	0	8.6	8.9	9.5	9.6	9.6	9.7	9.7	9.8	.0	.0
61	10	271	1	1	1	14	1X	1X	0	0	0	0	99	0	0	0	0	0	4.9	5.0	5.2	5.2	5.2	.0	.0	.0	.0	.0
61	10	272	1	1	1	12	1X	1X	0	0	0	0	99	0	0	0	0	0	4.8	5.2	5.2	6.0	6.0	.0	.0	.0	.0	.0
61	10	273	1	1	1	14	1X	1X	0	0	0	0	0	95	0	0	0	0	4.8	4.8	4.8	4.8	4.8	4.8	.0	.0	.0	.0
61	10	274	1	1	1	14	1X	1X	0	0	0	0	95	0	0	0	0	0	4.3	4.4	4.5	4.5	4.5	.0	.0	.0	.0	.0
61	10	275	2	2	2	34	3X	3X	0	9	52	64	52	92	0	0	0	0	24.4	24.5	24.7	24.7	24.8	24.8	.0	.0	.0	.0
61	10	276	2	2	2	44	4X	4X	0	0	0	0	90	0	0	0	0	0	29.3	29.4	29.4	29.5	29.5	.0	.0	.0	.0	.0
61	10	277	2	2	2	3X	3X	3X	0	0	52	99	0	0	0	0	0	0	27.3	27.4	27.5	27.5	.0	.0	.0	.0	.0	.0
61	10	278	2	2	2	3X	3X	3X	0	64	97	0	0	0	0	0	0	0	20.6	20.6	20.6	.0	.0	.0	.0	.0	.0	.0
61	10	279	2	2	2	34	34	34	0	0	52	0	0	0	62	0	0	92	27.1	27.2	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.4
61	10	280	2	2	2	33	34	3X	0	0	0	0	0	0	0	90	0	0	26.5	26.7	27.0	27.1	27.2	27.3	27.3	27.4	.0	.0
61	10	281	2	2	2	43	44	44	0	65	52	9	0	0	30	0	0	98	26.3	26.5	26.7	26.8	27.0	27.1	27.1	27.1	27.1	27.1
61	10	282	2	2	2	44	44	44	0	0	52	0	0	0	31	0	0	92	26.7	26.8	26.9	27.0	27.0	27.0	27.0	27.0	27.0	27.0

TABLE 1.11:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	11	1	1	1	1	22	23	24	0	0	0	0	0	0	0	0	0	0	23.7	24.1	24.5	24.9	25.4	25.6	25.7	26.0	26.1	26.4
61	11	2	1	1	1	22	23	23	0	0	0	0	0	0	0	0	0	0	24.3	24.7	25.3	25.4	25.9	26.2	26.3	26.4	26.7	27.1
61	11	3	1	1	1	22	22	24	0	0	0	0	0	0	0	0	0	0	21.9	22.3	22.7	23.1	23.5	24.0	24.0	24.3	24.5	24.7
61	11	4	1	1	1	22	23	22	0	0	0	0	0	65	0	0	0	0	13.7	14.1	14.5	15.0	15.2	15.5	15.8	15.9	16.2	16.9
61	11	5	1	1	1	22	22	23	0	0	0	0	0	0	0	0	30	0	20.2	20.6	21.0	21.4	21.8	22.2	22.3	22.7	23.0	23.4
61	11	6	1	1	1	22	22	22	0	0	0	0	0	0	0	0	0	52	18.9	19.6	20.0	20.7	20.9	21.5	21.7	22.0	22.4	22.9
61	11	7	1	1	1	22	22	22	0	0	0	0	0	0	31	0	0	52	18.9	19.4	19.8	20.3	20.7	21.1	21.5	21.9	22.2	22.7
61	11	8	1	1	1	22	22	22	0	0	0	0	0	0	0	0	0	0	17.2	18.1	18.3	18.7	19.2	19.8	20.0	20.5	21.0	21.8
61	11	9	1	1	1	20	21	21	0	0	0	0	0	0	0	0	0	0	18.7	19.6	20.5	21.5	22.2	23.1	23.4	23.9	24.4	25.5
61	11	10	1	1	1	20	21	21	0	0	0	0	0	0	30	0	0	0	14.7	15.4	16.0	16.8	17.5	18.3	18.7	19.2	19.7	21.0
61	11	11	1	1	1	20	21	21	0	0	0	0	0	0	0	0	0	0	16.7	17.5	18.2	19.2	20.0	20.8	21.2	21.8	22.5	23.4
61	11	13	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.9	5.9	6.8	7.8	9.7
61	11	14	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.5	5.4	6.2	7.1	8.0	9.0	10.6
61	11	15	1	1	1	1X	11	10	0	0	0	0	0	0	0	0	0	0	.0	.0	3.7	4.4	5.0	5.7	6.3	7.0	7.6	9.9
61	11	16	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.3
61	11	17	1	1	1	10	20	20	0	0	0	0	0	0	0	0	0	0	6.0	7.4	9.1	10.5	11.6	12.4	13.1	13.9	14.7	16.0
61	11	18	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.0	5.7	6.8	7.8	8.5	9.1	9.8	11.0
61	11	19	1	1	1	10	11	10	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.9	6.7	8.7	8.9	9.5	10.2	11.0	12.6
61	11	20	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.0	8.4
61	11	21	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.4
61	11	22	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	5.0	7.8
61	11	23	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	5.0	6.0	7.0	8.4
61	11	24	1	1	1	10	10	20	0	0	0	0	0	0	0	0	0	0	5.3	6.7	7.8	8.9	9.8	10.9	11.6	12.5	13.3	15.1
61	11	25	1	1	1	21	22	21	0	0	0	0	0	0	30	0	0	0	16.5	17.1	17.7	18.4	19.0	19.5	19.9	20.2	20.7	21.7
61	11	26	1	1	1	20	22	21	0	0	0	0	0	0	0	0	0	52	18.1	18.8	19.6	21.0	21.3	21.7	22.0	22.6	22.9	24.1
61	11	27	1	1	1	20	21	21	0	0	0	0	30	0	0	0	0	52	12.7	13.5	14.4	15.4	15.8	16.5	16.9	17.6	18.1	19.1
61	11	28	1	1	1	11	12	12	0	30	0	0	0	0	0	0	0	14	6.8	7.5	8.0	8.7	9.5	9.7	10.0	10.5	11.1	11.8
61	11	29	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	5.0	6.0	7.0	8.7
61	11	30	2	2	2	34	34	34	0	0	0	0	0	0	0	0	0	0	27.4	27.5	27.7	27.7	27.8	27.8	27.8	27.9	27.9	28.0
61	11	31	1	1	1	22	22	22	0	0	0	0	31	0	0	0	0	52	20.2	20.5	20.8	21.2	21.5	21.9	22.1	22.8	23.1	23.7

```
61  11   32    1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  5.0  6.2
61  11   33    1  1  1   10 11 11    0  0  0  0  0  0  0  0  0  0      .0  4.3  5.6  6.5  7.2  7.8  8.4  9.1  9.8 10.6
61  11   34    1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0  4.8  6.1  7.2  8.1  8.8  9.6 10.2 11.3
61  11   35    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  3.6  4.4  5.2  6.6
61  11   36    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  3.8  4.9  6.0  8.6
61  11   37    1  1  2   22 23 33    0  0  0  0  0  0 30 31  0  0    11.4 11.7 11.8 12.2 12.6 12.7 12.9 13.1 13.4 13.8
61  11   38    1  1  1   22 23 24    0  0  0  0  0 60 30 30  0  3    18.4 18.8 19.2 19.4 19.9 20.0 20.3 20.6 20.6 20.9
61  11   39    1  1  1   22 22 23    0  0  0  0  0 60 30 30  0  0    13.2 13.6 14.1 14.7 14.9 15.1 15.5 15.9 16.2 16.6
61  11   40    1  1  1   23 23 23    0  0  0  0  0 60 30 30  0  0    11.6 11.8 12.2 12.4 12.5 12.8 12.9 13.2 13.6 13.9
61  11   41    1  1  1   22 22 22    0  0  0  0  0 60 40  0  0  0    17.4 17.9 18.5 18.9 19.3 19.7 19.9 20.3 20.7 21.3

61  11   42    1  1  1   21 22 23    0  0  0  0  0  0  0  0  0  0    18.8 19.4 20.1 20.9 21.3 21.6 22.0 22.3 22.3 23.0
61  11   43    1  1  1   22 23 24    0  0  0  0  0  0  0  0  0  0    14.1 14.5 14.7 15.1 15.6 15.7 16.2 16.4 16.5 16.6
61  11   44    1  1  1   21 22 22    0  0  0  0  0  0  0  0  0  0    12.7 13.2 13.8 14.3 14.8 15.1 15.5 15.8 16.3 16.8
61  11   45    1  1  1   22 22 23    0  0  0  0  0  0  0  0  0 52    14.7 15.2 15.7 16.2 16.6 17.0 17.3 17.7 18.0 18.2
61  11   46    1  1  1   21 21 22    0  0  0  0  0  0 10  0  0 52    16.2 15.7 17.5 18.2 18.2 19.1 19.7 20.0 20.5 21.3
61  11   47    1  1  1   21 21 22    0  0  0  0  0  0  0  0  0 52    17.7 18.2 18.9 19.5 19.8 20.4 20.8 21.3 21.7 22.3
61  11   48    1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  4.8  6.1
61  11   49    1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.0  6.1
61  11   50    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  5.0  6.3
61  11   51    2  2  2   42 43 43    0  0  0  0  0  0 30  0  0  0    24.0 24.3 24.6 24.9 25.1 25.3 25.4 25.6 25.8 26.2

61  11   52    2  2  2   44 44 44    0  0  0  0  0 14 30  9  0  0    23.3 23.4 23.4 23.6 23.7 23.8 23.9 24.0 24.2 24.3
61  11   53    2  2  2   42 43 43    0  0  0  0  0  9  0  0  0  0    17.7 18.0 18.2 18.4 18.9 18.9 19.3 19.3 19.6 19.8
61  11   54    2  2  2   42 42 42    0 65  0  0  0  0  0  0  0  0    26.0 26.4 26.8 27.3 27.6 27.9 28.2 28.7 29.1 29.8
61  11   55    2  2  2   43 44 42    0 65 -2  0  0  0  0  0  0  0    29.3 29.5 29.7 29.8 30.0 30.2 30.2 30.2 30.7 31.1
61  11   56    1  1  1   21 21 22    0  0  0  0  0  0 30  0  0 52    15.8 16.4 17.0 17.7 18.2 18.8 19.3 19.8 20.2 21.1
61  11   57    1  1  1   14 14 14    0  0  9  0  0  0  0  0  0  4     8.4  8.5  8.6  8.7  8.8  8.8  8.8  8.9  9.0  9.1
61  11   58    1  1  1   21 22 22    0  0  0  0  0 30  0  0  0  0    20.6 21.2 21.8 22.5 23.1 23.5 23.7 24.2 24.5 25.0
61  11   59    2  2  2   43 43 44    0  0 -2  0  0  0 30  0  0  0    41.2 41.4 41.7 41.9 42.1 42.1 42.2 42.6 42.7 42.6
61  11   60    1  1  1   21 23 22    0  0  0  0  0  0  0  0  0  0    18.7 19.2 19.9 20.2 20.7 21.0 21.1 21.4 21.8 22.4
61  11   61    1  1  1   21 21 21    0  0  0  0  0  0 30 31  0  0    11.1 11.8 12.4 13.2 13.8 14.3 14.8 15.4 16.0 17.2

61  11   62    1  1  1   22 23 23    0  0  0  0  0  0  0  0  0  0    16.7 17.2 17.9 18.2 18.8 18.9 19.2 19.3 19.5 19.8
61  11   63    1  1  1   23 24 23    0  0  0  0  0  0 30  0  0  3    14.4 14.5 14.6 14.9 15.0 15.1 15.2 15.4 15.6 15.9
61  11   64    1  1  1   21 22 23    0  0  0  0  0  0 30  0  0  0    16.9 17.4 17.9 18.3 18.9 19.1 19.3 19.8 20.1 20.5
61  11   65    1  1  1   21 21 22    0  0  0  0  0  0  0  0  0  0    14.8 15.4 16.5 16.8 17.2 18.0 18.2 18.8 19.4 20.2
61  11   66    1  1  1   21 22 22    0  0  0  0 30  0 30  0  0  0    20.5 21.2 21.9 22.6 23.2 23.6 23.9 24.4 24.6 25.4
61  11   67    1  1  1   21 22 23    0  0  0  0  0  0  0  0  0  0    20.7 21.3 21.9 22.5 23.0 23.7 24.1 24.3 24.6 25.0
61  11   68    1  1  1   22 23 22    0  0  0  0  0  0  0  0  0  0    12.7 13.1 13.5 13.8 14.4 14.6 14.7 15.0 15.4 15.8
61  11   69    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  5.0  7.0
61  11   70    1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.1  6.1
61  11   71    1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.2  6.6

61  11   72    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.8  5.0  7.1
61  11   73    2  2  2   34 34 34    0  0  0  0  0  0  0  0  0  4     8.2  8.4  8.4  8.5  8.5  8.6  8.6  8.6  8.7  8.7
61  11   74    2  2  2   32 32 33    0  0  0  0  0  0  0  0  0  0    20.5 20.9 21.3 21.8 22.2 22.7 22.8 23.1 23.3 23.8
61  11   75    2  2  2   34 34 34    0  0  0  0  0  0  0  0  0 52    30.7 30.8 30.8 31.0 31.1 31.3 31.4 31.4 31.4 31.4
61  11   76    2  2  2   33 33 34    0  0  0  0  0  0  0  0  0 52    25.0 25.2 25.4 25.7 25.8 26.1 26.2 26.5 26.5 26.8
61  11   77    2  2  2   33 33 34    0  0  0  0  0  0  0  0  0  0    26.0 26.2 26.4 26.7 26.9 27.3 27.4 27.6 27.6 28.0
61  11   78    2  2  2   33 33 33    0  0  0  0  0  0  0  0  0  0    19.8 20.0 20.3 20.5 20.7 20.9 21.0 21.2 21.3 21.8
61  11   79    2  2  2   33 34 33    0 65  0  0  0  0  0  0  0  0    19.1 19.3 19.5 19.7 20.0 20.2 20.4 20.4 20.6 20.9
61  11   80    2  2  2   32 33 34    0  0  0  0  0  0  0  0  0  0    23.9 24.2 24.5 24.9 25.2 25.5 25.6 25.9 26.0 26.2
61  11   81    1  1  1   21 22 22    0  0  0  0 30  0 30  0  0  0    18.2 18.8 19.4 20.0 20.5 20.7 21.1 21.7 22.1 22.7

61  11   82    1  1  1   1X 11 13    0  0  0  0  0  0  0  0  0 52      .0   .0  4.2  5.0  5.7  6.4  7.0  7.6  7.8  8.1
61  11   83    1  1  1   20 21 22    0  0  0  0  0  0  0  0  0 52    11.0 11.8 12.7 13.7 14.3 14.9 15.2 15.9 16.4 16.8
61  11   84    1  1  1   10 12 12    0  0  0  0  0  0  0  0  0 52     6.5  7.3  8.4  9.2  9.8 10.3 10.7 11.2 11.8 12.4
61  11   85    1  1  1   20 22 22    0  0  0  0  0  0 30  0  0 52    14.9 15.7 16.7 17.4 18.1 18.6 18.8 19.4 19.8 20.7
61  11   86    2  2  2   32 34 34    0  0  0  0  0  0  0  0  0  0    24.9 25.2 25.6 25.9 26.0 26.2 26.3 26.4 26.5 26.6
61  11   87    2  2  2   32 32 32    0  0  0  0  0  0  0  0  0  0    18.3 18.7 19.0 19.4 19.8 19.9 20.2 20.6 21.0 21.6
61  11   88    2  2  2   43 44 44    0 64  0  0  0  0  0  0  0 52    20.0 20.2 20.3 20.5 20.7 20.7 20.7 20.7 20.7 20.8
61  11   89    2  2  2   43 44 44    0  0 -2  9  0  0  0  0  0  0    19.8 19.9 20.0 20.2 20.3 20.3 20.4 20.6 20.8 21.0
61  11   90    2  2  2   43 43 42    0  0 -2  0  0  0  0 30 30  0    22.8 23.1 23.3 23.9 23.9 23.9 24.1 24.5 24.6 25.3
61  11   91    2  2  2   42 44 43    0  0  0  0  0  0  0  0  0  0    18.9 19.2 19.3 19.8 20.1 20.1 20.2 20.3 20.5 20.9

61  11   92    2  2  2   42 42 42    0  0  0  0  0  9 30  0  0  0    21.9 22.2 22.5 22.9 23.2 23.4 23.7 24.2 24.6 25.4
61  11   93    2  2  2   43 43 44    0 64  0  0  0  0  0  0  0  0    18.0 18.2 18.4 18.6 18.7 18.8 18.9 19.1 19.3 19.5
61  11   94    2  2  2   42 42 43    0 14  0  0  0  0  0  0  0  0    14.4 15.5 15.8 16.2 16.4 16.8 16.9 17.3 17.5 18.0
61  11   95    2  2  2   44 43 44    0  3  0  0  0  0  0  0  0  0    23.8 24.0 24.1 24.4 24.4 24.7 24.8 25.0 25.1 25.4
61  11   96    2  2  2   32 32 32    0 64 52  3 30  0  0  0  0  0    26.8 27.1 27.4 27.8 28.1 28.4 28.7 29.0 29.4 29.9
61  11   97    2  2  2   32 33 33    0 64  0  0  0 14  0  0  0  0    18.7 19.0 19.3 20.0 19.8 20.0 20.2 20.3 20.5 20.8
61  11   98    2  2  2   34 34 34    0  0  0  0  0  0  0  0  0  0    21.7 21.8 21.9 22.0 22.0 22.0 22.0 22.0 22.1 22.1
61  11   99    2  2  2   33 34 33    0  0  0  0  0  0  0  0  0  0    28.4 28.6 28.7 29.0 29.1 29.3 29.5 29.5 29.7 30.0
61  11  100    1  1  1   10 21 21    0  0  0  0  0  0 30  0  0  0     9.6 10.5 11.7 12.6 13.3 13.9 14.4 15.1 15.8 16.7
61  11  101    1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.1  6.4

61  11  102    1  1  1   10 10 12    0  0  0  0  0  0  0  0  0  0     3.9  5.0  6.3  7.4  8.3  9.1  9.7 10.5 10.9 11.7
61  11  103    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  3      .0   .0   .0   .0   .0   .0  4.0  4.7  5.3  6.9
61  11  104    1  1  1   1X 10 12    0  0  0  0  0  0  0  0  0  2      .0   .0  4.0  5.8  6.8  7.8  8.6  9.4 10.1 10.5
61  11  105    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.8
61  11  106    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  3.8  4.6  5.4  6.2  7.9
61  11  107    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.7  5.5  7.0
61  11  108    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.8
61  11  109    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.9  4.8  6.4
61  11  110    1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.9  6.2
61  11  111    1  1  1   21 22 22    0  0  0  0  0  0  0  0  0  3    13.2 13.8 14.6 15.3 15.7 16.3 16.6 17.1 17.7 18.3

61  11  112    1  1  1   20 20 21    0  0  0  0  0  0  0  0  0  3    14.5 14.6 15.8 17.0 17.9 18.9 19.6 20.5 21.2 22.4
61  11  113    1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0  4.5  5.6  6.3  7.1  7.7  8.5  9.0 10.1
61  11  114    1  1  1   10 10 10    0  0  0  0  0  0  0  0  0  0     6.3  7.3  8.4  9.4 10.2 11.0 11.8 12.9 13.7 15.0
61  11  115    1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0      .0  4.3  5.2  6.0  6.7  7.3  7.9  8.6  9.2  9.9
61  11  116    1  1  1   11 12 11    0  0  0  0  0  0  0  0  0 14     7.8  8.3  9.1  9.8 10.3 10.6 10.9 11.5 12.0 13.2
61  11  117    1  1  1   10 20 21    0  0  0  0  0  0  0  0  0 14     8.7  9.7 11.0 12.0 12.7 13.4 13.9 14.8 15.3 16.5
61  11  118    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  5.5  7.0  9.6
61  11  119    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.7  4.5  6.0
61  11  120    1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.0  6.0
61  11  121    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.4  6.0  8.7

61  11  122    1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.5
61  11  123    1  1  1   1X 10 20    0  0  0  0  0  0  0 62  0  0      .0   .0  4.4  5.8  7.1  8.4  9.3 11.0 12.0 14.2
61  11  124    2  2  2   3X 3X 3X    0  0  2 98  0  0  0  0  0  0    18.1 18.2 18.3 18.3   .0   .0   .0   .0   .0   .0
61  11  125    1  1  1   10 1X 1X    0  0  0  0  0  0 97  0  0  0     5.0  5.9  7.0  7.9  8.5  9.0  9.0   .0   .0   .0
61  11  126    1  1  1   10 1X 1X    0  0  0  0  0  0 97  0  0  0     8.3  9.3 10.6 11.6 12.3 12.8 12.8   .0   .0   .0
61  11  127    1  1  1   10 1X 1X    0  0  0  0  0  0 97  0  0  0     6.4  7.5  8.8 10.0 10.9 11.6 11.6   .0   .0   .0
61  11  128    1  1  1   10 1X 1X    0  0  0  0  0  0 97  0  0  0     4.9  6.0  7.0  8.4  9.4 10.5 10.5   .0   .0   .0
61  11  129    1  1  1   11 1X 1X    0  0  0  0  0  0 97  0  0  0     5.2  5.7  6.3  6.9  7.2  7.6  7.6   .0   .0   .0
61  11  130    1  1  1   10 1X 1X    0  0  0  0  0  0 97  0  0  0     5.8  6.7  7.7  8.6  9.3 10.0 10.0   .0   .0   .0
61  11  131    1  1  1   10 1X 1X    0  0  0  0  0  0 97  0  0  0     6.2  7.2  8.4  9.5 10.2 11.0 11.0   .0   .0   .0
```

61	11	132	1	1	1	11	1X	1X	0	0	0	0	0	0	97	0	0	0	4.0	4.5	5.0	5.7	6.1	6.6	6.6	.0	.0	.0
61	11	133	1	1	1	10	1X	1X	0	0	0	0	0	0	97	0	0	0	5.4	6.4	7.5	8.6	9.3	9.9	9.9	.0	.0	.0
61	11	134	2	2	2	44	44	44	0	0	0	0	0	45	0	0	0	92	21.7	21.9	22.1	22.2	22.2	22.2	22.2	22.3	22.4	22.6
61	11	135	2	2	2	44	4X	4X	0	0	9	0	0	0	92	0	0	0	28.6	28.6	28.6	28.6	28.6	28.6	28.7	.0	.0	.0
61	11	136	2	2	2	43	44	44	0	0	0	0	0	13	0	0	0	92	22.4	22.6	22.9	23.1	23.1	23.1	23.1	23.1	23.3	23.3
61	11	137	2	2	2	34	3X	3X	0	0	9	0	0	92	0	0	0	0	24.8	24.8	24.8	24.8	24.8	24.8	.0	.0	.0	.0

TABLE 1.12:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	12	1	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.8	4.6	6.0
61	12	2	1	1	1	10	10	12	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.6	5.9	6.7	7.5	8.0	8.9	9.3	10.2
61	12	3	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	4.0	5.0	6.0	8.0
61	12	4	2	2	2	32	33	33	0	20	52	0	0	0	0	0	0	0	25.2	25.6	26.1	26.6	26.9	27.2	27.4	27.6	28.0	28.3
61	12	5	2	2	2	32	33	32	0	20	0	0	0	13	0	0	0	0	25.8	26.2	26.7	27.1	27.4	27.6	27.9	28.0	28.4	28.8
61	12	6	2	2	2	33	34	34	0	20	0	0	0	0	0	0	30	0	23.9	24.1	24.4	24.7	24.8	25.0	25.0	25.1	25.2	25.5
61	12	7	2	2	2	42	44	43	0	65	3	0	0	0	0	0	0	0	32.2	32.5	32.8	33.1	33.5	33.5	33.7	33.8	34.2	34.4
61	12	8	2	2	2	32	33	34	0	0	52	0	0	0	0	0	0	0	25.1	25.4	25.7	26.0	26.2	26.3	26.4	26.6	26.8	27.0
61	12	9	2	2	2	42	43	43	0	0	0	0	0	0	30	0	0	0	28.2	28.6	29.0	29.4	29.8	30.0	30.2	30.4	30.7	31.1
61	12	10	2	2	2	32	33	34	0	0	0	0	0	0	30	0	0	0	26.5	26.8	27.2	27.4	27.6	27.8	27.9	28.1	28.2	28.4
61	12	11	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.9	5.0	7.3
61	12	12	1	1	1	20	22	23	0	0	0	0	0	0	0	0	0	0	21.7	22.4	23.2	24.5	24.5	25.0	25.4	25.7	26.0	26.4
61	12	13	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.5	4.9	5.4	5.8	6.3	6.7	7.2	7.6	8.1	9.0
61	12	14	2	2	2	44	44	44	0	0	0	0	0	0	0	0	0	0	31.1	31.3	31.5	31.7	31.7	32.0	32.0	32.0	32.1	32.2
61	12	15	2	2	2	34	34	34	0	0	0	0	0	9	30	4	0	0	12.1	12.2	12.3	12.4	12.4	12.4	12.4	12.4	12.5	12.6
61	12	16	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.7	4.5	5.2	6.8
61	12	17	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.1
61	12	18	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	4.0	4.8	5.6	6.3	7.1	7.9	8.9	10.2
61	12	19	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	4.1	5.1	6.3	7.5	8.0	8.5	9.0	9.5	10.1	10.8
61	12	20	1	1	1	10	21	22	0	0	0	0	0	0	0	0	0	0	9.8	10.7	11.8	12.7	13.4	14.1	14.6	15.4	15.9	16.8
61	12	21	1	1	1	22	22	23	0	0	33	0	0	0	0	0	0	0	12.3	12.7	13.0	13.3	13.8	13.9	14.2	14.8	14.8	15.5
61	12	22	1	1	1	22	24	23	0	0	0	0	30	0	30	0	0	0	15.1	15.5	16.0	16.2	16.8	16.8	16.9	17.0	17.3	17.7
61	12	23	1	1	1	21	22	22	0	0	0	0	30	0	30	0	0	0	12.9	13.4	14.0	14.5	14.9	15.3	15.5	15.8	16.1	16.6
61	12	24	1	1	1	21	22	22	0	0	0	0	0	0	0	0	0	0	13.0	13.6	14.3	14.8	15.3	15.6	16.1	16.4	16.8	17.3
61	12	25	1	1	1	22	22	22	0	0	0	0	0	0	0	0	0	0	14.7	15.1	15.5	15.9	16.3	16.8	17.1	17.5	17.8	18.5
61	12	26	1	1	1	20	21	21	0	0	0	0	0	0	0	0	0	0	15.6	16.5	17.5	18.5	19.3	20.0	20.6	21.4	21.9	23.0
61	12	27	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.0	5.7	6.5	8.0
61	12	28	1	1	1	10	10	10	0	0	0	0	0	0	0	0	0	0	4.8	5.7	6.9	8.0	9.2	10.3	11.5	12.6	13.8	16.1
61	12	29	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.8	5.2	5.7	6.1	6.6	7.0	7.5	7.9	8.4	9.3
61	12	30	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.4
61	12	31	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.6	5.3	6.8
61	12	32	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.6	5.0	5.4	5.8	6.2	6.6	6.9	7.2	7.5	8.2
61	12	33	1	1	1	22	22	22	0	0	0	0	0	0	0	0	0	0	8.9	9.3	9.8	10.2	10.7	11.1	11.6	12.0	12.5	13.4
61	12	34	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	0	6.4	6.5	6.6	6.8	7.0	7.2	7.4	7.6	7.8	8.1
61	12	35	1	1	1	22	22	12	0	0	0	0	0	0	0	0	0	0	7.7	8.1	8.5	8.9	9.1	9.3	9.5	10.0	10.8	11.0
61	12	36	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	9.3	9.7	10.1	10.5	10.9	11.7
61	12	37	1	1	1	10	12	22	0	14	0	0	0	0	30	0	0	0	10.8	11.5	12.5	13.2	13.7	14.2	14.4	14.7	15.2	16.1
61	12	38	1	1	1	12	12	13	0	0	0	0	0	0	0	0	0	0	4.6	5.0	5.5	6.1	6.3	6.7	6.9	7.1	7.4	7.8
61	12	39	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.7	4.3	4.9	6.3
61	12	40	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.7	6.2
61	12	41	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	2	3.6	4.1	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.6
61	12	42	1	1	1	12	12	13	0	0	0	0	0	0	0	0	0	0	.0	4.1	4.3	4.6	5.0	5.3	5.7	5.8	6.0	6.3
61	12	43	1	1	1	1X	12	13	0	0	0	0	0	0	0	0	0	14	.0	.0	4.1	4.5	4.9	5.2	5.5	5.7	5.9	6.3
61	12	44	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.3	5.1	6.6
61	12	45	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	.0	.0	4.0	4.7	6.2
61	12	46	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	5.4	6.4	7.6	8.7	9.5	10.1	10.7	11.4	12.0	12.8
61	12	47	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.7	4.3	5.0	5.6	6.3	6.9	7.6	8.9
61	12	48	1	1	1	1X	13	13	0	0	0	0	0	0	0	0	0	0	.0	.0	5.7	6.0	6.3	6.6	6.9	7.0	7.2	7.5
61	12	49	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	4	.0	.0	.0	.0	.0	.0	.0	4.0	4.5	6.0
61	12	50	1	1	1	20	21	22	0	0	0	0	0	0	30	0	0	0	12.0	12.9	14.0	15.1	15.7	16.3	16.8	17.4	17.9	18.8
61	12	51	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.4	6.0	7.1	8.3	9.2	10.4	11.2	12.4
61	12	52	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.3
61	12	53	1	1	1	1X	12	13	0	0	0	0	0	0	0	0	0	2	.0	.0	6.1	6.4	6.7	7.0	7.3	7.6	7.9	8.4
61	12	54	2	2	2	43	43	43	0	0	45	9	0	0	30	0	0	0	28.3	28.5	28.7	28.9	29.2	29.4	29.5	29.7	29.9	30.2
61	12	55	2	2	2	43	43	43	0	0	0	0	0	0	30	0	0	0	21.3	21.5	21.7	22.0	22.2	22.3	22.5	22.7	23.0	23.4
61	12	56	2	2	2	44	44	4X	0	0	0	0	0	4	0	0	0	0	20.3	20.4	20.4	20.5	20.5	20.5	20.5	20.5	20.5	.0
61	12	57	2	2	2	44	44	44	0	0	0	0	0	45	30	0	0	0	20.7	20.8	20.8	20.8	20.8	20.8	20.9	20.9	21.0	21.0
61	12	58	2	2	2	42	43	42	0	64	52	0	0	0	30	0	30	0	25.8	26.1	26.6	26.8	27.1	27.3	27.3	27.7	27.9	28.5
61	12	59	2	2	2	43	42	42	0	0	52	0	0	0	0	0	0	0	31.2	31.4	31.7	32.0	32.0	32.6	32.8	33.2	33.5	34.1
61	12	60	2	2	2	43	44	44	0	3	0	0	0	0	0	0	0	0	28.4	28.6	28.7	29.1	29.1	29.4	29.5	29.5	29.6	29.6
61	12	61	2	2	2	43	44	43	0	0	0	0	30	0	30	0	30	0	25.6	25.8	25.8	26.1	26.3	26.4	26.5	26.6	26.8	27.2
61	12	62	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	52	5.2	6.3	7.6	8.7	9.6	10.4	11.4	12.2	12.9	13.8
61	12	63	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	0	4.2	4.7	5.3	5.8	6.2	6.7	7.1	7.5	7.9	8.0
61	12	64	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.6	5.2	5.9	7.2
61	12	65	1	1	1	12	12	13	0	0	0	0	0	0	30	0	0	0	7.2	7.5	7.9	8.5	8.5	9.0	9.2	9.6	9.7	10.4
61	12	66	1	1	1	23	23	23	0	0	0	0	0	30	0	0	0	0	15.0	15.2	15.5	15.8	15.9	16.3	16.4	16.7	17.0	17.3
61	12	67	2	2	2	23	23	24	0	0	0	0	0	0	0	0	0	52	12.2	12.4	12.6	12.8	13.0	13.2	13.4	13.7	13.9	14.0
61	12	68	1	1	1	23	23	24	0	0	0	0	0	0	0	0	0	0	14.3	14.5	14.8	15.1	15.2	15.3	15.5	15.8	16.0	16.2
61	12	69	1	1	1	22	22	23	0	0	0	0	0	0	0	0	0	0	16.4	16.7	17.0	17.3	17.5	17.9	17.9	18.4	18.4	18.9
61	12	70	1	1	1	11	23	22	0	0	0	0	0	0	30	0	0	0	11.2	11.5	11.9	13.0	13.0	13.1	13.4	13.7	14.1	14.7
61	12	71	1	1	1	21	22	22	0	0	0	0	0	0	30	0	0	0	13.6	14.1	14.6	15.1	15.6	15.9	16.3	16.8	17.3	17.9
61	12	72	1	1	1	24	24	24	0	0	0	0	0	0	30	0	0	0	11.9	12.0	12.1	12.3	12.3	12.4	12.4	12.5	12.5	12.5
61	12	73	1	1	1	23	23	24	0	0	0	0	0	0	30	0	0	0	16.4	16.6	16.8	17.2	17.3	17.5	17.6	17.9	18.1	18.2
61	12	74	1	1	1	12	13	23	0	0	0	0	0	0	30	0	0	21	10.4	10.7	11.1	11.4	11.6	11.9	12.0	12.3	12.4	12.8
61	12	75	1	1	1	22	22	22	0	0	0	0	0	0	30	0	0	0	15.4	15.8	16.2	16.7	17.1	17.4	17.7	18.0	18.4	18.8
61	12	76	1	1	1	22	22	22	0	0	0	0	0	0	30	0	0	0	20.4	20.7	21.1	21.5	21.8	22.3	22.5	22.8	23.2	23.6
61	12	77	1	1	1	22	22	23	0	0	0	0	0	0	0	0	0	0	15.4	15.8	16.3	16.7	17.0	17.4	17.6	18.1	18.5	18.9
61	12	78	1	1	1	22	22	22	0	0	0	0	0	0	30	0	0	0	19.7	20.2	20.7	21.1	21.6	21.9	22.1	22.6	22.9	23.5
61	12	79	2	2	2	32	32	32	0	0	0	0	0	0	30	0	0	21	22.1	22.4	22.9	23.4	23.4	23.8	24.1	24.4	24.7	25.4
61	12	80	2	2	2	34	34	34	0	64	0	0	0	0	30	0	0	0	22.5	22.6	22.7	22.8	23.0	23.2	23.2	23.2	23.4	23.5

61	12	81	2	2	2	32	34	34	0	0	0	0	0	30	0	0	0	0	21.7	22.0	22.4	22.7	22.9	23.0	23.0	23.1	23.1	23.3
61	12	82	2	2	2	32	33	33	0	64	0	0	0	0	0	0	0	0	22.8	23.2	23.7	23.8	24.4	24.7	24.8	24.9	25.3	25.5
61	12	83	2	2	2	33	33	33	0	65	0	0	0	0	30	0	0	0	18.1	18.3	18.6	18.8	18.8	19.1	19.3	19.3	19.6	20.0
61	12	84	2	2	2	32	32	32	0	0	0	0	0	0	30	0	0	0	29.6	30.1	30.7	31.1	31.5	31.8	32.0	32.4	32.6	33.0
61	12	85	2	2	2	32	32	32	0	0	0	0	0	0	30	0	0	0	13.7	14.0	14.4	14.8	15.0	15.4	15.5	15.9	16.2	16.8
61	12	86	2	2	2	32	32	32	0	0	0	0	0	0	30	0	0	0	19.8	20.1	20.5	21.0	21.0	21.4	21.6	22.0	22.3	23.1
61	12	87	2	2	2	32	33	32	0	0	0	0	0	14	30	0	0	0	19.3	19.7	20.0	20.4	20.8	20.9	21.1	21.5	21.7	22.4
61	12	88	2	2	2	33	34	34	0	3	2	0	0	0	30	0	0	0	22.4	22.7	22.8	23.0	23.1	23.1	23.3	23.3	23.4	23.7
61	12	89	2	2	2	41	42	42	0	3	52	0	0	9	30	0	0	0	34.9	35.4	36.0	36.5	37.0	37.3	37.7	38.0	38.4	39.3
61	12	90	1	1	2	22	23	32	0	3	0	0	0	30	31	0	0	0	17.1	17.5	17.9	18.2	18.6	18.9	19.0	19.2	19.5	20.1
61	12	91	2	2	2	32	33	32	0	0	0	0	0	0	30	0	0	0	23.3	23.7	24.2	24.6	24.9	25.2	25.5	25.6	26.1	26.8
61	12	92	2	2	2	32	33	33	0	3	0	0	0	0	30	0	0	0	28.9	29.2	29.6	30.0	30.2	30.3	30.4	30.6	30.9	31.2
61	12	93	2	2	2	34	34	34	0	14	0	0	0	0	0	4	0	0	8.4	8.5	8.5	8.5	8.6	8.6	8.6	8.8	8.8	9.0
61	12	94	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	0	5.2	6.5	8.0	9.4	10.3	11.3	12.0	12.9	13.6	14.5
61	12	95	1	1	1	10	11	21	0	0	33	0	0	0	30	0	0	0	5.7	6.8	8.3	9.4	10.2	10.9	11.5	12.2	12.9	13.7
61	12	96	1	1	1	12	12	13	0	0	0	0	0	0	0	0	0	0	6.0	6.3	6.6	7.0	7.4	7.8	8.0	8.2	8.4	8.7
61	12	97	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.8	4.4	5.2	6.0	7.5
61	12	98	1	1	1	11	12	13	0	33	0	0	0	0	30	0	0	0	5.4	5.9	6.7	7.3	7.5	7.8	8.0	8.4	8.5	9.0
61	12	99	1	1	1	11	12	12	0	0	0	0	0	0	30	0	0	0	6.2	6.8	7.6	8.0	8.7	9.1	9.4	9.9	10.3	10.7
61	12	100	1	1	1	10	12	12	0	0	0	0	0	0	30	0	0	0	5.0	5.9	7.0	7.9	8.5	8.9	9.1	9.8	10.3	11.0
61	12	101	1	1	1	20	22	22	0	0	0	0	0	0	30	0	0	0	19.8	20.5	21.3	22.0	22.7	23.2	23.5	24.1	24.5	25.4
61	12	102	1	1	1	12	12	13	0	0	0	0	0	0	30	0	0	0	7.1	7.5	7.9	8.5	8.6	9.0	9.1	9.6	9.8	10.1
61	12	103	1	1	1	22	22	22	0	0	0	0	0	30	30	0	0	0	13.3	13.7	14.1	14.6	14.9	15.3	15.6	16.1	16.5	17.2
61	12	104	1	1	1	12	12	23	0	14	0	0	0	0	30	0	0	0	9.7	10.0	10.2	10.5	10.8	11.0	11.1	11.6	11.9	12.3
61	12	105	1	1	1	12	12	12	0	0	0	0	0	14	0	0	0	0	4.0	4.3	4.7	5.0	5.3	5.6	5.9	6.2	6.5	7.0
61	12	106	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.2	7.9
61	12	107	2	2	2	42	43	44	0	0	0	0	0	0	0	0	0	0	16.6	16.9	17.3	17.5	17.7	17.9	18.1	18.3	18.4	18.5
61	12	108	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.8	4.3	5.1	5.9	6.6	7.2	8.6
61	12	109	2	2	2	32	33	31	0	65	0	0	0	3	30	0	0	0	28.1	28.4	28.7	28.8	29.2	29.4	29.6	29.6	30.3	31.1
61	12	110	2	2	2	33	33	33	0	0	0	0	0	13	0	0	0	52	16.3	16.5	16.7	16.9	17.1	17.4	17.5	17.7	18.0	18.4
61	12	111	2	2	2	34	34	33	0	0	0	0	0	0	30	0	0	0	23.0	23.1	23.3	23.4	23.5	23.7	23.8	23.9	24.0	24.3
61	12	112	2	2	2	34	34	34	0	0	52	0	0	9	0	0	0	0	11.7	11.8	11.9	11.9	12.0	12.2	12.2	12.3	12.4	12.7
61	12	113	2	2	2	32	43	42	0	0	0	0	0	0	30	0	0	0	20.4	20.7	21.0	21.3	21.7	22.0	22.3	22.4	22.8	23.2
61	12	114	1	1	1	21	22	22	0	0	0	0	0	0	0	0	0	20	20.2	20.8	21.4	22.0	22.5	22.9	23.3	23.7	24.2	24.9
61	12	115	1	1	1	21	21	21	0	0	0	0	0	0	30	0	0	0	15.1	15.7	16.4	17.1	17.6	18.1	18.6	19.3	19.9	21.1
61	12	116	1	1	1	23	23	23	0	0	0	0	0	3	30	0	0	0	22.2	22.4	22.6	22.8	23.0	23.1	23.5	23.5	23.8	24.2
61	12	117	1	1	1	23	23	24	0	0	0	0	0	0	30	30	0	0	14.7	14.9	15.3	15.4	15.4	15.6	15.7	15.8	16.0	16.1
61	12	118	1	1	1	22	22	22	0	0	0	0	0	0	0	0	0	0	17.1	17.5	18.0	18.6	18.8	19.4	19.8	20.2	20.7	21.3
61	12	119	1	1	1	23	23	23	0	0	33	0	0	0	0	0	0	0	12.0	12.2	12.3	12.9	12.9	12.9	13.1	13.3	13.7	13.9
61	12	120	1	1	1	12	12	12	0	0	0	0	0	0	30	0	0	0	5.3	5.8	6.2	6.7	7.2	7.5	7.8	8.3	8.6	9.3
61	12	121	1	1	1	22	22	22	0	0	0	0	0	0	30	0	0	0	14.7	15.1	15.5	15.9	16.4	16.7	17.0	17.5	17.8	18.8
61	12	122	1	1	1	21	22	22	0	0	0	0	0	0	30	0	0	0	15.3	15.9	16.5	17.0	17.6	17.9	18.3	18.9	19.3	19.9
61	12	123	1	1	1	23	22	23	0	0	0	0	0	0	30	0	0	0	16.7	16.9	17.3	17.6	17.6	18.1	18.3	18.6	18.9	19.3
61	12	124	1	1	1	22	22	22	0	0	0	0	0	0	30	0	0	0	16.1	16.5	16.9	17.3	17.7	18.1	18.4	19.0	19.2	20.0
61	12	125	2	2	2	44	4X	3X	0	65	52	0	91	0	0	0	0	0	25.4	25.6	25.8	26.0	26.0	.0	.0	.0	.0	.0
61	12	126	2	2	2	34	34	3X	0	0	0	0	0	0	30	0	0	0	23.0	23.1	23.1	23.2	23.2	23.4	23.4	23.4	.0	.0
61	12	127	2	2	2	34	34	34	0	0	0	0	0	40	30	41	0	93	22.6	22.8	23.0	23.2	23.2	23.4	23.4	23.4	23.5	23.5
61	12	128	2	2	2	34	34	3X	0	64	0	0	0	0	30	91	0	0	15.8	15.8	15.8	15.8	15.9	15.9	15.9	15.9	.0	.0
61	12	129	1	1	1	24	2X	2X	0	0	9	33	95	0	0	0	0	0	12.9	12.9	12.9	12.9	12.9	.0	.0	.0	.0	.0

TABLE 1.13:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	13	1	2	2	2	33	33	34	0	0	0	0	0	0	0	0	0	0	29.3	29.5	29.9	30.0	30.2	30.4	30.5	30.7	30.7	30.8
61	13	2	2	2	2	22	23	24	0	0	0	0	0	0	0	0	0	0	18.2	18.5	19.2	19.4	19.8	19.9	20.1	20.3	20.4	20.6
61	13	3	1	1	1	12	13	13	0	0	9	0	0	33	0	0	0	0	8.7	9.0	9.4	9.6	9.9	10.1	10.2	10.4	10.7	10.9
61	13	4	2	2	2	23	24	23	0	0	9	0	0	0	0	0	0	0	15.7	15.9	16.1	16.3	16.4	16.5	16.5	16.7	16.9	17.2
61	13	5	2	2	2	20	22	33	0	0	0	0	0	0	0	0	0	0	13.8	15.4	19.8	20.2	20.3	20.7	20.8	21.1	21.5	21.7
61	13	6	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.2	5.0	5.8	6.6	7.4	8.2	9.8
61	13	7	1	1	2	10	11	22	0	33	3	0	0	0	0	0	0	0	7.7	8.4	9.6	10.0	10.6	11.1	11.6	12.5	13.1	13.5
61	13	8	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.5	5.0	5.5	6.5
61	13	9	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.0	4.6	5.2	5.9	6.4	6.9	7.9
61	13	10	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	2	2	.0	.0	.0	.0	.0	3.9	4.4	5.0	5.4	6.4
61	13	11	2	2	2	32	31	32	0	0	0	0	0	0	30	0	0	0	25.0	25.5	26.0	26.4	26.9	27.5	27.9	28.6	28.9	29.9
61	13	12	2	2	2	33	34	34	0	0	0	0	0	0	30	0	0	0	30.6	30.8	31.0	31.2	31.5	31.5	31.8	31.8	31.9	32.1
61	13	13	2	2	2	42	42	42	0	0	0	0	0	0	30	0	0	0	29.2	29.5	29.8	30.1	30.4	30.8	31.0	31.4	31.8	32.5
61	13	14	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.6	5.4	5.8	6.3	7.3
61	13	15	2	2	2	22	23	33	0	0	30	0	0	30	30	9	0	0	14.9	15.2	15.5	15.8	16.0	16.2	16.3	16.5	16.8	17.0
61	13	16	2	2	2	21	22	22	0	0	52	0	0	3	30	30	30	0	17.8	18.3	18.9	19.4	19.9	20.3	20.8	21.1	21.5	22.5
61	13	17	2	2	2	22	23	23	0	0	0	0	0	0	30	0	30	30	13.4	13.7	14.1	14.3	14.6	14.8	15.0	15.1	15.3	15.8
61	13	18	2	2	2	21	21	22	0	0	0	0	0	0	30	0	30	0	16.5	17.1	17.8	18.4	19.0	19.6	20.1	20.6	21.0	21.9
61	13	19	2	2	2	22	22	22	0	0	0	0	0	0	30	0	0	0	16.9	17.3	17.8	18.3	18.6	19.0	19.3	19.7	20.1	20.8
61	13	20	2	2	2	22	23	23	0	0	0	0	0	0	30	0	0	0	17.7	18.1	18.6	19.0	19.4	19.8	19.9	20.0	20.3	20.5
61	13	21	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0
61	13	22	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.5	5.0	6.0
61	13	23	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	5.2	6.4	7.3	8.2	9.2	10.1	11.5
61	13	24	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	4.6	5.0	6.0
61	13	25	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.4	5.8	6.3	6.7	7.1	7.6	8.0	8.4	8.9	9.7
61	13	26	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.7	5.3	5.8	6.3	7.3
61	13	27	1	1	1	1X	12	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	4.5	4.8	5.3	5.9	6.9
61	13	28	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.6	5.1	6.0
61	13	29	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	5.1	6.2	7.1	7.7	8.4	9.2	10.4
61	13	30	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.6	5.6	6.7	7.6	8.5	9.0	10.2
61	13	31	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.2	4.5	4.8	5.2	5.5	6.0	6.7
61	13	32	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.3	4.7	5.2	6.1
61	13	33	2	2	2	33	33	32	0	64	0	0	0	0	30	0	0	0	25.4	25.8	26.2	26.5	26.5	27.0	27.2	27.2	27.5	28.1
61	13	34	2	2	2	32	33	33	0	0	52	0	0	0	30	0	0	0	22.4	22.7	23.1	23.3	23.6	23.8	23.9	24.1	24.3	24.6
61	13	35	2	2	2	34	34	34	0	0	0	0	31	0	30	0	0	0	15.2	15.2	15.2	15.3	15.3	15.4	15.6	15.6	15.6	15.6
61	13	36	2	2	2	34	34	34	0	0	0	0	31	0	30	0	0	0	11.1	11.3	11.5	11.6	11.6	11.8	11.8	12.0	12.1	12.2
61	13	37	2	2	2	24	24	24	0	20	0	0	32	30	30	30	0	0	18.6	18.7	18.9	18.9	18.9	19.1	19.1	19.1	19.2	19.2
61	13	38	2	2	2	32	32	32	0	65	52	0	0	0	0	0	0	0	32.8	33.3	33.8	34.3	34.7	35.4	35.7	36.1	36.5	37.3
61	13	39	2	2	2	32	33	34	0	65	0	0	0	0	0	30	30	0	21.7	22.1	22.3	22.5	23.2	23.2	23.4	23.6	23.7	23.9
61	13	40	3	2	2	32	33	33	0	0	0	0	0	0	30	0	0	0	24.0	24.3	24.6	25.2	25.3	25.5	25.7	25.9	26.1	26.6

61	13	41	2	2	2	32	33	33	0	0	0	0	0	0	0	0	0	0	24.1	24.4	24.7	25.0	25.2	25.4	25.7	25.9	26.1	26.5
61	13	42	2	2	2	33	33	33	0	0	0	0	0	0	0	0	0	0	21.3	21.5	21.7	21.9	22.1	22.2	22.6	22.8	23.1	23.4
61	13	43	2	2	2	43	44	44	0	0	0	0	0	0	0	0	30	0	29.1	29.3	29.5	29.6	29.8	29.8	30.0	30.1	30.1	30.5
61	13	44	2	2	2	33	33	33	0	0	0	0	0	0	0	0	0	0	23.4	23.6	23.9	24.1	24.3	24.6	24.7	24.8	25.0	25.3
61	13	45	2	2	2	34	33	33	0	0	0	0	0	0	30	0	0	0	14.9	15.0	15.0	15.3	15.4	15.6	15.7	15.9	16.1	16.4
61	13	46	2	2	2	32	32	33	0	0	0	0	0	0	30	0	0	0	28.0	28.4	28.8	29.2	29.7	30.0	30.2	30.6	30.9	31.3
61	13	47	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.7	4.3	5.0	6.2
61	13	48	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.1	4.6	5.0	5.4	6.6
61	13	49	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	.0	4.2	4.6	5.0	5.4	5.8	6.3	6.6	6.9	7.5
61	13	50	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	.■	4.2	4.■	5.5	6.2	6.8	7.5	8.2	9.0	10.2
61	13	51	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.9	4.3	4.6	5.0	5.4	5.9	6.4
61	13	52	1	1	2	10	10	21	0	0	0	0	0	0	0	0	0	0	3.9	5.0	6.2	7.3	8.3	9.0	10.0	10.9	11.7	12.9
61	13	53	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.■	4.0	4.3	4.6	5.0	5.4	5.8	6.4
61	13	54	1	1	1	1X	12	13	0	0	0	0	0	0	0	0	0	0	.0	.0	3.8	4.1	4.4	4.7	5.1	5.3	5.7	6.0
61	13	55	1	1	1	12	12	13	0	0	0	0	0	0	0	0	0	73	4.1	4.3	4.6	5.2	5.5	5.7	6.0	6.3	6.6	7.0
61	13	56	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.1	4.8	5.5	6.2	6.9	7.6	8.6	9.7
61	13	57	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.3	4.7	5.2	5.5	6.2
61	13	58	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.5	5.0	6.2
61	13	59	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.4	5.0	5.4	5.8	6.4
61	13	60	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	35	5.■	5.7	6.0	6.4	6.8	7.1	7.5	7.9	8.5	9.0
61	13	61	1	1	1	1X	11	12	0	0	0	0	0	0	33	33	34	35	.0	.0	.0	3.8	4.3	4.9	5.5	5.8	6.3	7.1
61	13	62	1	1	1	12	12	13	0	0	0	0	0	0	0	0	0	0	.0	4.2	4.6	5.0	5.4	5.7	5.9	6.2	6.3	6.6
61	13	63	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	5.9	6.7	7.6	8.5	9.2	9.8	10.4	11.0	11.4	11.9
61	13	64	1	1	1	1X	12	12	0	0	0	0	0	33	33	33	34	35	.0	.0	.0	3.8	4.2	4.5	4.7	5.3	5.7	6.1
61	13	65	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.4	5.7	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.4
61	13	66	1	2	2	20	21	22	0	0	0	0	0	0	0	0	0	52	11.2	12.1	13.2	14.2	14.7	15.6	16.1	16.7	17.3	18.0
61	13	67	1	1	1	11	11	13	0	0	0	0	0	0	0	0	0	0	4.7	5.6	6.5	7.3	7.3	8.2	8.5	8.9	9.2	9.5
61	13	68	1	1	2	11	13	24	0	33	0	0	0	0	0	0	0	9	8.6	9.2	10.3	10.8	11.1	11.3	11.7	11.8	12.0	12.1
61	13	69	1	1	1	11	11	12	0	0	0	0	0	0	0	0	0	0	6.3	6.9	7.5	8.1	8.6	9.1	9.5	10.1	10.4	11.0
61	13	70	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	0	5.5	6.0	6.8	7.3	7.5	7.9	8.0	8.4	8.5	8.8
61	13	71	1	1	1	13	14	14	0	0	0	0	0	0	0	0	0	0	4.6	4.7	4.9	5.1	5.3	5.4	5.5	5.6	5.7	6.0
61	13	72	1	1	1	11	13	14	0	0	0	0	0	0	0	0	0	0	3.9	4.4	4.9	5.1	5.9	6.3	6.5	6.6	6.7	6.9
61	13	73	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	0	5.2	5.■	6.5	7.0	7.5	7.8	8.0	8.4	8.7	8.9
61	30	74	1	1	1	11	11	13	0	0	0	0	0	0	0	0	0	1	4.6	5.2	5.8	6.3	7.0	7.4	7.9	8.5	8.9	9.0
61	13	75	1	1	1	11	12	12	0	0	33	0	0	0	0	0	0	0	6.7	7.3	8.1	8.7	9.2	9.9	10.1	10.5	10.9	11.6
61	13	76	1	1	1	13	14	14	0	0	0	0	0	0	0	0	0	0	4.6	4.8	5.1	5.2	5.3	5.5	5.6	5.7	5.8	6.0
61	13	77	1	1	1	12	13	14	0	0	0	0	0	0	0	0	0	0	4.9	5.■	5.6	5.9	6.1	6.4	6.5	6.6	6.9	6.9
61	13	78	1	1	1	12	13	14	0	33	0	0	0	0	0	0	0	0	7.7	8.1	8.7	9.1	9.4	9.7	9.8	10.1	10.1	10.2
61	13	79	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	0	5.6	6.0	6.5	6.8	7.2	7.4	7.6	7.9	8.2	8.5
61	13	80	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.0	5.4	5.■	6.2	6.6	7.0	7.4	7.8	8.3	8.8
61	13	81	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	6.1	■.6	7.2	7.6	8.2	8.6	8.9	9.2	9.6	10.3
61	13	82	1	1	1	11	13	12	0	0	0	0	0	0	0	0	0	0	4.1	4.6	5.2	5.7	6.1	6.4	6.7	6.9	7.2	7.7
61	13	83	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	0	6.6	6.9	7.4	7.7	7.9	8.1	8.2	8.4	8.6	8.9
61	13	84	1	1	1	12	14	14	0	0	0	0	0	0	0	0	0	0	6.8	7.1	7.6	7.8	8.1	8.2	8.3	8.5	8.6	8.8
61	13	85	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	3	8.2	8.7	9.5	9.9	10.3	10.6	11.0	11.2	11.4	11.7
61	13	86	1	1	2	11	11	21	0	3	0	0	0	0	0	0	0	0	7.9	8.6	9.5	10.2	10.7	11.2	11.7	12.3	12.9	13.8
61	13	87	1	1	1	11	13	13	0	0	0	0	0	0	0	0	0	0	3.7	4.2	4.9	5.4	5.7	6.0	6.2	6.4	6.6	7.0
61	13	88	1	1	2	11	11	22	0	0	0	0	0	0	0	0	0	0	7.8	8.4	9.2	9.4	10.3	10.9	11.3	12.0	12.6	12.8
61	13	89	1	1	1	13	14	14	0	33	0	0	0	0	0	0	0	3	8.4	8.6	8.9	9.1	9.3	9.4	9.5	9.6	9.6	9.7
61	13	90	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	0	6.3	6.■	7.6	8.3	8.8	9.2	9.7	10.1	10.5	10.8
61	13	91	1	1	1	13	13	14	0	0	0	0	0	0	0	0	0	0	4.5	4.7	4.■	5.1	5.3	5.5	5.6	5.8	5.9	6.1
61	13	92	1	1	2	10	11	12	0	0	0	0	0	0	0	0	0	0	7.6	8.8	9.9	10.8	11.4	12.1	12.6	13.3	14.0	14.7
61	13	93	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	5.0	5.6	6.5	7.0	7.5	7.9	8.2	8.6	9.0	9.7
61	13	94	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	0	5.9	6.1	6.6	6.8	6.8	6.9	7.1	7.3	7.5	7.8
61	13	95	1	1	1	12	13	14	0	0	0	0	0	0	0	0	0	0	.0	3.9	4.4	4.7	5.2	5.3	5.4	5.6	5.7	6.0
61	13	96	1	1	1	12	12	12	0	33	0	0	0	0	0	0	0	2	6.0	6.5	6.■	7.5	7.9	8.3	8.6	9.1	9.4	10.0
61	13	97	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.8	6.■	6.4	6.7	7.0	7.3	7.6	7.9	8.3	8.9
61	13	98	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	0	5.4	6.0	6.7	7.4	7.9	8.3	8.7	9.1	9.3	9.8
61	13	99	1	1	1	10	12	11	0	0	0	0	0	0	0	0	0	0	.0	4.3	5.■	6.2	7.0	7.4	8.0	8.1	9.3	10.1
61	13	100	1	1	1	10	11	12	0	0	0	0	0	0	30	0	0	2	4.6	5.4	6.4	7.3	7.9	8.4	8.9	9.4	9.8	10.3
61	13	101	1	1	2	11	12	21	0	0	0	0	0	0	0	0	0	0	7.4	8.1	8.9	9.6	10.2	10.7	11.1	11.6	12.1	13.7
61	13	102	1	1	2	10	11	22	0	33	0	0	0	0	0	0	0	0	8.7	9.4	10.1	11.0	11.5	12.0	12.5	13.2	13.6	14.5
61	13	103	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	6.5	7.1	7.■	8.4	8.9	9.3	9.7	10.1	10.4	11.0
61	13	104	1	1	2	10	21	22	0	0	0	26	20	20	20	20	20	0	8.■	9.8	11.1	12.1	12.4	13.2	13.5	14.4	14.9	15.4
61	13	105	1	1	2	11	12	22	0	0	0	0	0	0	0	0	0	0	9.2	9.8	10.6	11.0	11.5	11.9	12.2	12.8	13.1	13.7
61	13	106	1	1	1	10	10	10	0	0	0	0	0	0	0	0	0	0	.0	3.■	4.6	5.3	6.1	6.8	7.6	8.3	9.2	10.5
61	13	107	1	1	1	10	11	10	0	0	0	0	0	0	30	0	0	33	3.7	5.1	6.7	8.0	9.2	9.6	10.2	10.7	11.3	12.8
61	13	108	1	2	2	10	20	21	0	0	0	0	0	14	0	0	0	0	8.0	9.2	10.6	11.6	12.7	13.5	14.3	15.1	15.9	16.7
61	13	109	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	0	4.9	5.0	5.4	5.6	5.7	5.9	6.1	6.4	6.6	7.0
61	13	110	1	1	1	10	10	11	0	0	0	0	0	0	0	0	■	0	4.2	5.2	6.3	7.4	8.2	9.0	9.8	10.6	11.4	12.5
61	13	111	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	4.0	4.6	5.2	5.8	6.4	7.0	7.6	8.2	8.9	9.9
61	13	112	1	1	2	10	10	21	0	0	0	0	0	0	0	■	0	0	6.0	7.1	8.3	9.5	10.4	11.1	11.8	12.7	13.3	14.4
61	13	113	1	1	1	10	11	12	0	0	0	0	0	0	0	0	■	0	5.■	6.6	7.7	8.5	9.1	9.6	10.1	10.6	11.1	11.7
61	13	114	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	3.9	4.7	5.7	6.5	7.2	7.8	8.3	8.9	9.5	10.2
61	13	115	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	.■	3.9	4.5	4.9	5.6	6.3	6.5	6.8	7.4	8.1
61	13	116	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	■.9	5.3	5.7	6.1	6.5	6.9	7.3	7.7	8.1	8.8
61	13	117	1	1	1	10	10	11	0	0	0	0	0	0	30	0	0	0	.0	4.1	5.7	7.0	8.1	8.8	9.6	10.4	11.1	11.9
61	13	118	1	1	1	12	12	12	0	0	0	0	0	0	0	0	■	0	.0	4.1	4.4	4.7	5.0	5.4	5.7	6.0	6.4	7.0
61	13	119	2	2	2	44	44	44	0	5	61	52	0	0	30	0	0	0	28.0	28.2	28.3	28.3	28.3	28.4	28.5	28.6	28.9	28.9
61	13	120	1	1	2	10	10	11	0	0	0	0	0	0	0	0	■	0	.0	4.4	5.8	7.3	8.3	9.3	10.1	11.1	11.8	13.0
61	13	121	1	1	1	1X	13	12	0	0	0	0	0	0	■	0	0	0	.0	.0	4.0	4.3	4.6	5.0	5.0	5.4	5.7	6.2
61	13	122	1	1	1	10	12	13	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.3	5.5	5.9	6.3	6.5	6.8	7.0	7.5
61	13	123	2	2	2	42	44	44	0	5	0	0	■	0	30	0	0	52	32.2	32.5	32.9	33.2	33.3	33.5	33.5	33.6	33.7	33.8
61	13	124	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.0	4.3	4.6	5.0	5.4	5.7	6.2	6.7
61	13	125	2	2	2	42	42	42	0	5	0	0	0	3	30	0	0	0	25.4	25.8	26.3	26.5	26.9	27.2	27.6	28.0	28.3	28.8
61	13	126	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	■	0	.0	.0	.0	.0	.0	.0	4.0	4.7	5.2	6.2
61	13	127	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.■	4.4	4.9	5.2	5.6	6.0	6.4	7.2
61	13	128	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	■	0	.0	.■	3.9	4.3	4.8	5.1	5.5	5.8	6.1	6.7
61	13	129	1	1	1	10	12	11	0	0	0	0	0	0	0	0	0	0	3.■	4.5	5.4	6.1	6.7	7.0	7.6	8.0	8.7	9.6
61	13	130	1	2	2	10	20	21	0	0	34	0	0	33	30	0	0	0	8.5	9.5	10.8	12.0	12.6	13.3	14.1	15.1	15.9	17.0
61	13	131	1	1	2	10	12	22	0	0	34	0	0	0	0	0	0	0	7.2	7.7	8.4	10.2	10.6	11.0	11.5	11.8	12.3	12.6
61	13	132	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	4.0	5.1	6.4	7.5	8.3	8.9	9.4	10.1	10.6	11.4
61	13	133	1	1	2	10	10	21	0	0	0	0	0	0	0	■	0	0	5.5	6.6	7.9	9.1	9.9	10.5	11.3	12.0	12.7	13.8
61	13	134	1	1	2	10	10	21	0	0	0	0	0	0	30	0	0	0	5.7	6.9	8.1	9.3	10.4	11.4	12.2	13.2	13.8	14.7
61	13	135	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	4.0	4.6	5.2	5.8	6.4	7.0	7.7	8.3	9.2	10.2
61	13	136	1	1	2	10	11	21	0	0	0	0	0	0	30	0	0	0	5.7	6.8	7.9	9.3	10.2	10.7	11.4	12.1	12.9	13.8
61	13	137	2	2	2	22	22	22	0	0	0	0	0	0	30	0	0	0	16.4	16.8	17.2	17.7	18.1	18.6	18.9	19.3	19.8	20.4
61	13	138	2	2	2	21	32	32	0	0	0	0	0	■	30	■	0	0	17.8	18.4	19.2	19.3	20.1	20.6	20.7	21.0	21.3	21.8
61	13	139	2	2	2	21	31	32	0	0	0	0	0	0	30	0	0	0	17.■	18.4	19.■	19.7	20.2	20.8	21.2	21.7	22.3	22.9
61	13	140	2	2	2	30	31	32	0	0	0	0	0	0	30	0	0	0	20.2	21.0	21.9	22.4	23.3	23.6	24.0	24.8	24.9	25.8

61	13	141	2	2	2	30	33	33	0	0	0	0	0	0	0	0	0	0	21.5	22.2	23.1	23.5	24.4	24.6	25.0	25.1	25.3	25.6
61	13	142	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.9	5.3	5.7	6.1	6.5	6.9	7.3	7.7	8.2	8.9
61	13	143	1	1	1	11	12	12	0	0	34	0	0	0	30	0	0	0	4.7	5.3	6.0	6.6	7.0	7.4	7.8	8.0	8.4	8.8
61	13	144	1	1	2	10	11	21	0	0	0	0	0	0	30	0	0	0	6.3	7.2	8.2	9.1	9.8	10.4	11.0	11.7	12.3	13.2
61	13	145	1	1	1	13	14	14	0	0	0	0	0	0	0	0	0	0	5.8	5.9	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8
61	13	146	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	0	6.7	7.3	8.1	8.6	9.1	9.6	9.9	10.3	10.7	11.0
61	13	147	1	1	2	11	11	22	0	0	0	0	0	0	0	0	0	0	6.9	7.6	8.4	9.0	9.6	10.1	10.5	11.2	11.8	12.5
61	13	148	1	1	1	12	12	13	0	0	0	0	0	0	0	0	0	0	5.7	6.1	6.7	7.0	7.4	7.7	7.9	8.2	8.4	8.6
61	13	149	1	1	2	11	12	22	0	0	0	0	0	0	0	0	0	0	9.5	10.0	10.6	11.2	11.5	11.7	12.2	12.5	12.9	13.4
61	13	150	1	1	1	13	13	14	0	0	0	0	0	0	0	0	0	0	6.3	6.4	6.5	6.7	6.9	7.1	7.3	7.4	7.5	7.7
61	13	151	1	1	1	11	11	12	0	0	0	0	0	0	0	0	0	0	7.0	7.7	8.5	9.2	9.7	10.3	10.7	11.4	12.0	12.8
61	13	152	1	1	1	11	10	11	0	0	0	0	0	0	0	0	0	0	3.7	4.5	5.3	6.1	6.2	7.3	7.8	8.4	9.0	10.0
61	13	153	1	1	1	10	13	12	0	0	[illegible]	0	0	0	0	0	0	0	5.9	6.8	7.4	8.8	9.4	9.7	10.0	10.1	10.3	11.1
61	13	154	1	1	1	12	12	13	0	0	9	0	0	0	0	0	0	0	4.1	4.6	5.1	5.7	6.0	6.3	6.6	6.8	7.0	7.4
61	13	155	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	6.3	7.1	8.1	8.9	9.5	10.0	10.5	11.0	11.4	12.2
61	13	156	1	1	1	10	11	12	0	14	0	0	0	33	0	0	0	0	4.9	5.9	7.0	8.2	9.1	9.6	10.2	10.8	11.2	12.0
61	13	157	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	3.5	4.5	5.5	6.7	7.5	8.2	8.8	9.5	10.3	11.3
61	13	158	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	3.6	4.2	5.1	6.0	7.1	7.6	8.0	8.6	9.1	9.9
61	13	159	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	4.6	5.6	6.6	7.5	8.5	9.0	9.8	10.5	11.2	12.3
61	13	160	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	0	6.1	6.3	6.5	6.7	6.9	7.1	7.4	7.6	7.9	8.2
61	13	161	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.1	8.5	9.1
61	13	162	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.2	5.5	5.8	6.1	6.4	6.7	7.0	7.3	7.6	8.2
61	13	163	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	3	.0	4.2	4.6	5.1	5.5	5.9	6.3	6.7	7.0	7.5
61	13	164	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	3.7	4.4	5.1	5.8	6.6	7.3	7.9	8.6	9.3	10.2
61	13	165	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	20	.0	3.9	4.5	5.1	5.7	6.3	6.9	7.5	8.1	9.3
61	13	166	1	1	1	10	11	12	0	0	0	0	0	35	0	0	0	2	4.0	4.7	5.3	6.0	7.0	7.5	8.0	8.6	9.1	9.7
61	13	167	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	4.9	5.4	5.9	6.4	6.9	7.4	7.9	8.4	8.9	9.9
61	13	168	1	1	1	1X	12	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.1	4.5	5.0	5.5	5.9	6.4	7.4
61	13	169	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.9	4.4	4.9	6.0
61	13	170	2	2	2	32	34	33	0	0	0	0	0	0	30	30	0	0	28.7	29.1	29.7	29.9	30.2	30.4	30.4	30.5	30.7	31.0
61	13	171	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	0	4.2	4.5	4.8	5.1	5.3	5.5	5.7	5.9	6.1	6.4
61	13	172	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	2	.0	.0	.0	.0	.0	4.0	4.4	4.8	5.2	6.0
61	13	173	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	0	5.6	6.0	6.6	7.0	7.3	7.5	7.7	7.9	7.9	8.3
61	13	174	1	1	2	11	12	22	0	0	0	0	0	0	0	0	0	0	7.7	8.3	9.0	9.7	10.1	10.5	10.8	11.3	11.7	12.2
61	13	175	1	1	1	1X	13	13	0	0	0	0	0	0	0	0	[illegible]	35	.0	.0	4.0	4.3	4.6	4.8	5.1	5.3	5.6	6.0
61	13	176	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.2	4.4	4.7	5.0	5.3	5.7	6.1	6.5	6.9	7.7
61	13	177	2	2	2	33	33	34	0	0	52	0	0	60	30	0	0	0	25.2	25.4	25.7	26.0	26.1	26.3	26.5	26.7	26.7	26.9
61	13	178	2	2	2	22	23	23	0	34	0	0	0	0	30	0	0	0	17.1	17.5	18.2	18.6	18.8	18.9	19.1	19.4	19.6	19.8
61	13	179	1	1	1	12	13	13	0	0	0	0	0	33	34	34	34	35	5.0	5.3	5.6	5.9	6.2	6.5	6.7	6.8	6.9	7.3
61	13	180	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.1	4.5	5.0	5.5	6.5
61	13	181	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.7	4.3	4.8	5.3	5.8	6.9
61	13	182	1	1	1	10	10	11	0	0	0	0	0	0	0	0	0	0	3.6	4.3	5.2	6.1	6.9	7.6	8.4	9.1	9.5	11.0
61	13	183	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	3	.0	4.2	4.6	5.0	5.4	5.8	6.2	6.5	6.8	7.3
61	13	184	2	2	2	43	44	44	0	64	52	9	0	0	0	0	0	0	34.5	34.7	35.1	35.1	35.2	35.2	35.2	35.3	35.6	35.6
61	13	185	2	2	2	43	43	44	0	14	52	20	64	0	0	0	0	0	33.6	33.8	34.0	34.3	34.4	34.5	34.6	34.9	34.9	34.9
61	13	186	1	1	2	21	22	22	0	0	0	0	0	0	30	0	0	0	20.5	21.1	21.9	22.6	23.0	23.7	24.0	24.4	24.8	25.4
61	13	187	1	1	2	12	12	12	0	0	0	0	0	0	30	0	0	0	9.4	9.7	10.2	10.7	11.0	11.4	11.7	12.1	12.5	13.0
61	13	188	2	2	2	23	24	24	0	0	0	0	0	0	0	31	0	0	18.2	18.5	18.9	19.2	19.2	19.3	19.3	19.3	19.4	19.5
61	13	189	2	2	2	22	22	22	0	0	0	0	0	0	30	30	0	0	16.6	17.0	17.4	18.1	18.3	18.6	19.0	19.2	19.4	20.0
61	13	190	2	2	2	23	24	24	0	0	0	0	0	0	30	31	0	0	13.7	13.9	14.1	14.3	14.4	14.5	14.6	14.6	14.6	14.7
61	13	191	2	2	2	21	22	22	0	0	0	0	0	0	0	31	0	0	17.5	18.1	18.8	19.3	19.9	20.2	20.5	21.0	21.4	21.9
61	13	192	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	.0	4.0	4.3	4.6	4.9	5.2	5.5	5.8	6.2	6.6
61	13	193	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	.0	3.8	4.2	4.5	4.8	5.2	5.4	5.7	6.1	6.6
61	13	194	2	2	2	41	42	42	0	0	0	0	0	0	0	0	0	0	31.5	32.0	32.7	33.2	33.5	34.1	34.4	34.8	35.1	36.0
61	13	195	2	2	2	32	33	33	0	0	0	0	0	3	30	30	0	0	26.7	27.0	27.4	27.6	27.9	28.1	28.3	28.4	28.6	29.0
61	13	196	2	2	2	32	33	33	0	0	0	0	0	0	30	0	0	0	23.7	24.0	24.5	24.8	24.9	25.1	25.3	25.4	25.6	26.1
61	13	197	1	2	2	20	21	21	0	0	0	0	0	0	30	0	0	0	15.3	16.0	16.7	17.7	18.1	18.9	19.5	20.1	20.6	21.6
61	13	198	1	1	1	11	13	13	0	33	0	0	0	3	0	0	0	2	7.2	7.7	8.3	8.9	9.3	9.5	9.6	9.9	10.2	10.4
61	13	199	2	1	1	2X	2X	2X	0	0	90	0	0	0	0	0	0	0	15.9	15.9	15.9	.0	.0	.0	.0	.0	.0	.0
61	13	200	2	2	2	24	24	24	0	0	0	0	0	30	32	32	32	98	22.1	22.2	22.2	22.2	22.3	22.3	22.4	22.4	22.4	22.5
61	13	201	2	2	1	22	2X	2X	0	0	0	0	91	0	0	0	0	0	14.8	15.2	15.9	16.5	16.5	.0	.0	.0	.0	.0
61	13	202	2	2	1	3X	3X	3X	0	0	92	0	0	0	0	0	0	0	23.7	23.7	23.7	.0	.0	.0	.0	.0	.0	.0
61	13	203	2	2	2	33	32	34	0	0	0	0	0	40	40	41	42	93	29.7	29.9	29.9	30.1	30.5	30.9	31.3	31.7	31.9	32.0
61	13	204	2	2	2	34	34	34	0	64	0	0	0	0	40	41	42	93	27.4	27.5	27.6	27.6	27.7	27.7	27.7	27.7	27.7	28.0
61	13	205	2	2	2	34	3X	3X	0	0	0	0	0	33	93	0	0	0	25.3	25.5	25.8	25.8	25.8	25.9	26.0	.0	.0	.0
61	13	206	2	2	2	43	4X	4X	0	65	0	0	76	0	0	0	0	0	27.9	28.1	28.4	28.7	28.7	28.8	.0	.0	.0	.0
61	13	207	2	2	2	42	4X	4X	0	65	0	0	52	90	0	0	0	0	20.5	20.8	21.1	21.5	21.7	21.7	.0	.0	.0	.0
61	13	208	1	1	1	11	11	1X	0	0	0	0	0	0	0	0	97	0	3.6	4.3	5.0	5.8	6.4	7.1	7.6	8.2	8.2	.0
61	13	209	1	1	1	1X	10	1X	0	0	0	0	0	0	0	0	97	0	.0	.0	.0	4.5	5.6	6.5	7.3	8.0	8.0	.0

TABLE 1.14:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	14	1	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.0
61	14	2	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.3	6.1
61	14	3	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.8
61	14	4	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.1	4.7	5.3	6.0	7.3
61	14	5	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	3.8	4.3	5.0	6.4
61	14	6	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	2	2	.0	.0	.0	.0	.0	.0	.0	.0	4.1	6.1
61	14	7	1	1	1	11	11	14	0	0	0	0	0	0	0	0	0	0	14.7	15.0	15.6	16.2	16.9	17.3	17.8	18.7	18.9	19.0
61	14	8	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.8	6.1
61	14	9	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.4	5.1	6.5
61	14	10	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.5	5.4	7.3
61	14	11	2	2	2	32	34	34	0	0	0	0	60	0	0	0	0	60	34.1	34.4	34.8	35.1	35.2	35.2	35.2	35.5	35.5	35.5
61	14	12	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.9	6.3
61	14	13	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.1	5.6	6.5	7.4	8.3	9.0	9.7	10.8
61	14	14	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	4.2	5.1	6.2	7.1	7.8	8.2	8.6	9.2	9.7	10.2
61	14	15	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.0	5.6	7.1
61	14	16	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.5
61	14	17	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.7	4.7	5.7	6.7	7.7	8.7	8.7
61	14	18	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.1	4.7	5.2	6.0	7.4
61	14	19	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.9	4.6	5.3	6.0	7.7
61	14	20	1	1	1	10	11	12	0	0	0	0	0	14	30	0	0	0	.0	4.1	5.4	6.4	7.0	7.6	8.1	8.5	8.8	9.3

```
61  14   21   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  3      .0   .0   .0   .0   .0   .0   .0  4.2  5.3  6.1
61  14   22   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     4.1  5.0  6.2  7.2  7.7  8.2  8.8  9.3  9.8 10.3
61  14   23   1  1  1   10 11 12    0 33  0  0  0  0  0  0  0  3     4.2  5.1  6.2  7.1  7.8  8.4  8.8  9.5  9.9 10.6
61  14   24   1  1  1   10 10 22    0 33  0  0  0  0 30  0  0 52     3.8  5.2  6.7  8.3  9.5 10.4 11.2 12.0 12.5 13.2
61  14   25   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.6  4.3  6.0
61  14   26   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.6
61  14   27   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     4.8  5.5  6.2  7.0  7.6  8.1  8.6  9.2  9.8 10.5
61  14   28   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.8  6.2
61  14   29   1  1  1   10 1X 1X    0  0  0  0  0  0 92  0  0  0      .0  3.9  4.9  5.8  6.5  7.0  7.0   .0   .0   .0
61  14   30   1  1  1   1X 12 12    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.2  4.6  5.0  5.4  5.8  6.4

61  14   31   1  1  1   22 22 23    0  0  0  0  0  0  0  0  0  3    17.5 17.9 18.4 18.9 19.2 19.7 19.8 20.0 20.2 20.6
61  14   32   1  1  1   11 10 11    0  0  0  0  0  0  0  0  0  0      .0  4.2  4.8  5.8  6.2  7.4  8.0  8.8  9.4 10.6
61  14   33   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0     5.8  6.1  6.4  6.7  7.0  7.3  7.6  7.9  8.2  8.8
61  14   34   1  1  1   10 11 11    0  0  0  0  0  0  0  0  0  0     5.2  6.1  7.2  8.0  8.8  9.3  9.9 10.6 11.1 12.1
61  14   35   1  1  1   12 13 12    0  0  0  0  0  0  0  0  0  0     5.8  6.0  6.3  6.5  6.8  7.0  7.3  7.5  7.8  8.3
61  14   36   1  1  1   22 23 22    0  0  0  0  0  0 31  0  0  0    19.5 19.9 20.5 20.9 21.2 21.3 21.4 21.7 22.4 22.9
61  14   37   1  1  1   10 12 12    0  0  0  0  0 33  0  0  0  0     5.3  6.0  6.7  7.7  8.2  8.6  9.1  9.6 10.1 10.6
61  14   38   1  1  1   13 12 13    0  0  0  0  0  0  0  0  0 14     6.2  6.5  6.7  7.0  7.2  7.5  7.7  8.0  8.2  8.7
61  14   39   1  1  1   10 12 13    0 33 33  0 33 33 33  0 33 33     6.0  6.7  7.5  8.2  8.9  9.4  9.8 10.2 10.5 10.8
61  14   40   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  3      .0   .0   .0   .0   .0   .0   .0   .0  4.1  6.5

61  14   41   1  1  1   10 11 22    0  0  0  0  0  0  0  0  0  3     6.8  7.6  8.5  9.6 10.0 10.7 11.2 11.9 12.5 13.2
61  14   42   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0     5.0  5.7  6.1  6.4  6.7  7.1  7.4  7.7  8.2  8.7
61  14   43   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0 70 13      .0   .0   .0   .0   .0   .0   .0   .0  4.0  6.2
61  14   44   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0 33 33      .0   .0   .0   .0   .0  3.6  4.3  5.2  6.0  7.3
61  14   45   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  5.0  6.3
61  14   46   1  1  1   13 13 13    0  0  0  0  0  0  0  0  0  0     6.1  6.3  6.5  6.7  6.9  7.1  7.3  7.5  7.7  8.1
61  14   47   1  1  1   10 12 12    0  0  0  0  0  0  0  0  0  0     5.5  6.3  7.4  8.3  8.8  9.3  9.8 10.2 10.7 11.4
61  14   48   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     5.0  5.8  6.7  7.5  8.1  8.7  9.2  9.9 10.3 11.3
61  14   49   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0 70 14      .0   .0   .0   .0   .0   .0  4.2  5.3  6.0  7.2
61  14   50   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0 70 14      .0   .0   .0   .0   .0   .0  4.1  5.2  5.9  7.1

61  14   51   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.6  5.2  6.9
61  14   52   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0 53      .0   .0   .0   .0   .0   .0   .0  4.2  5.0  6.2
61  14   53   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  3     5.0  5.8  6.9  7.7  8.3  8.9  9.4  9.9 10.4 10.9
61  14   54   1  1  1   11 12 12    0  0  0  0  0  0  0  0  0  0     4.4  5.1  6.0  6.6  7.2  7.6  8.0  8.5  8.9  9.4
61  14   55   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  5.0  7.5
61  14   56   2  2  2   32 33 33    0 20 42  0  0  0  0  0  0  0    20.0 20.3 20.6 20.9 21.1 21.3 21.5 21.6 21.9 22.2
61  14   57   2  2  2   43 44 44    0  0  0  0  0  0  0  0  0  0    30.5 30.7 30.9 31.0 31.3 31.4 31.5 31.7 31.9 32.0
61  14   58   1  1  1   11 11 11    0  0  0  0  0  0  0  0  0  0      .0  4.2  4.7  5.3  5.8  6.4  6.9  7.5  8.0  9.1
61  14   59   1  1  1   10 10 21    0  0  0  0  0  0  0  0  0  0     5.9  6.8  7.8  8.8  9.5 10.3 11.0 11.8 12.5 13.6
61  14   60   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.9  5.2  7.6

61  14   61   1  1  1   1X 1X 11    0  0  0  0  0  0 31 31 33 33      .0   .0   .0   .0   .0   .0  4.0  4.6  5.0  6.1
61  14   62   1  1  1   10 11 22    0  0  0  0  0  0  0  0  0  0     7.9  8.7  9.6 10.5 11.2 11.8 12.4 13.1 13.5 14.4
61  14   63   1  1  1   11 12 12    0 34  0  0  0  0  0  0  0  0     5.9  6.5  7.2  8.0  8.4  8.8  9.2  9.7  9.9 10.5
61  14   64   1  1  1   1X 1X 10    0  0  0  0  0 31 31 31 32 33      .0   .0   .0   .0   .0  4.1  4.6  5.2  5.8  7.4
61  14   65   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0     5.5  5.8  6.2  6.5  6.8  7.2  7.5  7.8  8.4  8.8
61  14   66   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0     4.9  5.9  7.2  8.3  9.0  9.6 10.2 10.8 11.3 12.2
61  14   67   1  1  1   11 1X 1X    0  0  0  0  0  0 92  0  0  0     4.9  5.4  6.0  6.7  7.1  7.2  7.2   .0   .0   .0
61  14   68   1  1  1   10 12 12    0  0  0  0  0  0  0  0  0  0      .0  3.8  4.7  5.4  6.0  6.3  6.6  6.9  7.2  7.9
61  14   69   1  1  1   10 11 22    0  0 33  0  0  0  0  0  0 14     7.7  8.5  9.6 10.4 11.0 11.8 12.3 12.9 13.7 13.8
61  14   70   1  1  1   11 12 12    0  0  0  0  0  0  0  0  0  0     4.9  5.5  6.3  6.8  7.3  7.7  8.0  8.4  8.9  9.2

61  14   71   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0 70 14      .0   .0   .0   .0   .0   .0   .0  4.1  5.0  6.4
61  14   72   1  1  1   11 11 12    0 34  0  0  0  0  0  0  0  3     6.6  7.3  8.1  8.7  9.3  9.8 10.2 10.8 11.2 11.7
61  14   73   1  1  1   11 11 12    0  0  0  0  0  0  0  0  0  3     5.5  6.2  7.0  7.6  8.2  8.7  9.1  9.8 10.2 10.8
61  14   74   1  1  1   11 12 14    0  0  0  0  0  3  0  0  0  0     8.3  8.8  9.6 10.2 10.3 10.7 10.8 11.1 11.3 11.4
61  14   75   1  1  1   12 13 12    0 34  0  0  0 14 14 14 14 14     4.2  4.6  5.0  5.5  5.9  6.2  6.2  6.4  6.8  7.3
61  14   76   1  1  1   10 11 21    0  0 22  0  0 23  0  0  0  0     7.5  8.2  9.0  9.6 10.3 10.9 11.3 12.0 12.6 13.5
61  14   77   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0 70 14      .0   .0   .0   .0   .0   .0  4.0  4.6  5.2  6.7
61  14   78   1  1  1   1X 11 11    0  0  0  0 33 33 34 35  3  3      .0   .0   .0  4.0  4.6  5.3  6.0  6.6  7.2  8.7
61  14   79   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  3     7.1  8.0  9.0 10.0 10.7 11.3 11.8 12.5 13.0 13.7
61  14   80   1  1  1   10 21 22    0  0  0  0  0  0  0  0  0  0     8.8  9.9 11.1 12.3 13.2 13.8 14.5 15.1 15.8 16.5

61  14   81   1  1  1   10 12 13    0  0  0  9  0  0  0  0  0  3     3.9  4.6  5.5  6.2  6.8  7.3  7.7  8.1  8.5  8.9
61  14   82   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  3     4.7  5.7  6.8  7.8  8.6  9.3  9.9 10.5 11.2 11.9
61  14   83   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0 70 13      .0   .0   .0   .0   .0   .0   .0   .0  4.0  6.0
61  14   84   1  1  1   1X 11 12    0  0  0  0  0  0  0 35 33  3      .0   .0   .0  4.0  4.6  5.2  5.8  6.4  7.0  7.6
61  14   85   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  3.8  4.3  5.0  5.4  6.9
61  14   86   1  1  1   1X 1X 10    0  0  0  0  0  0  0 70 14 14      .0   .0   .0   .0   .0   .0  3.6  4.3  6.0  7.4
61  14   87   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.0  4.6  5.2  6.6
61  14   88   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  3.9  4.6  5.2  6.0  6.6  8.0
61  14   89   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.1  4.9  6.2
61  14   90   2  2  2   42 43 44    0  0  0  0  0  0 30  0  0 57    36.3 36.6 37.0 37.3 37.6 37.9 37.9 38.1 38.2 38.5

61  14   91   2  2  2   32 33 32    3  3  3  3  3  3  3  3  3  3    22.5 22.9 23.3 23.7 24.1 24.5 24.7 24.9 25.2 25.7
61  14   92   2  2  2   32 33 34    0  0  0  0  0  0  0  9  0  0    25.4 25.8 26.3 26.6 27.0 27.2 27.2 27.6 27.7 27.9
61  14   93   2  2  2   30 32 32    0  0  0  0  0  0  0  0  0  0    20.8 21.6 22.5 23.2 23.9 24.5 24.8 25.3 25.7 26.6
61  14   94   1  1  1   1X 1X 10    0  0  0  0  0 33 33 35  3  3      .0   .0   .0   .0   .0  4.1  4.8  5.2  5.8  7.4
61  14   95   1  1  1   1X 10 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0  4.0  5.2  6.1  7.1  7.6  9.1
61  14   96   1  1  1   1X 1X 1X    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0   .0  4.0  6.1
61  14   97   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0 70 14      .0   .0   .0   .0   .0   .0  4.1  4.7  5.4  6.2
61  14   98   1  1  1   1X 11 10    0  0  0  0  0  0  0  0 70 14      .0   .0   .0   .0  4.1  4.7  5.4  6.0  6.5  8.3
61  14   99   1  1  1   1X 12 10    0  0  0  0  0  0  0  0  0 35      .0   .0   .0  4.2  5.0  5.3  5.5  5.9  6.6  8.3
61  14  100   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.0  4.6  5.0  5.6  6.9

61  14  101   1  1  1   1X 12 12    0  0  0  0  0  0  0 70 14 14      .0   .0   .0  4.1  4.6  5.2  5.6  6.0  6.6  7.1
61  14  102   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0 70 14      .0   .0   .0   .0   .0   .0   .0  3.9  4.6  6.1
61  14  103   2  2  2   32 33 34    0  0 42  0  0  0  0  0  0  0    28.0 28.4 28.8 29.2 29.6 30.0 30.0 30.3 30.7 30.7
61  14  104   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  4.5  6.2
61  14  105   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  3.8  4.4  6.2
61  14  106   2  2  2   42 44 43    0  0 52  0  0  9 30 30 35  9    29.2 29.6 29.9 30.3 30.6 30.7 30.8 30.9 31.0 31.3
61  14  107   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0     4.6  5.1  5.5  6.0  6.4  6.9  7.3  7.8  8.2  9.1
61  14  108   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0     5.6  5.9  6.3  6.6  6.9  7.3  7.6  7.9  8.4  8.9
61  14  109   1  1  1   12 12 12    0  0  0  0  0  0  0  0  0  0     4.7  5.1  5.6  6.0  6.4  6.9  7.3  7.7  8.4  9.0
61  14  110   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  5.7  6.4  7.0  8.1

61  14  111   1  1  1   10 11 12    0  0  0  0  0  0  0  0  0  0      .0  4.2  5.7  6.9  7.8  8.5  9.2  9.8 10.4 11.1
61  14  112   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.1  4.9  5.6  6.3  7.5
61  14  113   1  1  1   11 11 11    0  0  0  0  0  0  0  0  0  0     4.1  4.6  5.2  5.7  6.3  6.8  7.3  7.9  8.5  9.5
61  14  114   1  1  1   1X 1X 11    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  4.6  6.0
61  14  115   1  1  1   1X 1X 10    0  0  0  0  0  0  0 32  0  2      .0   .0   .0   .0   .0   .0   .0  4.2  4.9  6.6
61  14  116   1  1  1   1X 1X 10    0  0  0  0  0  0  0 32  2  2      .0   .0   .0   .0   .0   .0   .0  4.1  5.0  6.7
61  14  117   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0  4.1  4.7  5.5  7.0
61  14  118   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0  4.0  4.6  5.2  6.0  7.6
61  14  119   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.3  5.1  6.8
61  14  120   1  1  1   1X 1X 10    0  0  0  0  0  0  0  0  0  0      .0   .0   .0   .0   .0   .0   .0  4.0  4.5  6.1
```

61	14	121	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.7	6.1
61	14	122	1	1	1	21	21	21	0	0	0	0	0	0	0	0	0	0	16.3	17.0	17.6	18.3	19.0	19.7	20.2	20.9	21.6	22.8
61	14	123	1	1	1	20	22	23	0	0	0	0	0	0	0	0	0	0	15.4	16.5	18.0	18.8	19.7	20.1	20.5	20.6	20.8	21.4
61	14	124	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.0
61	14	125	1	1	1	1X	1X	10	0	0	0	0	0	0	0	70	14	14	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.5
61	14	126	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.1
61	14	127	1	1	1	1X	1X	10	0	0	0	0	0	0	0	70	14	14	.0	.0	.0	.0	.0	4.2	5.0	5.7	6.2	8.0
61	14	128	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.4	5.3	6.3	7.2	8.1	9.3	10.9
61	14	129	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.0
61	14	130	1	1	1	10	21	21	0	0	0	0	0	0	0	0	0	0	10.3	11.0	11.8	12.5	13.1	13.8	14.0	15.0	15.7	16.7
61	14	131	1	1	1	20	21	21	0	0	0	0	0	0	0	0	0	0	10.5	17.3	18.1	19.0	19.7	20.6	20.9	21.6	22.1	23.3
61	14	132	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.6	6.0
61	14	133	1	1	1	1X	1X	10	0	0	0	0	0	0	0	70	14	14	.0	.0	.0	.0	.0	4.0	4.5	5.2	6.0	7.5
61	14	134	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.4	6.2	6.8
61	14	135	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.3
61	14	136	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.6	5.2	6.5
61	14	137	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.2
61	14	138	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	4.8	5.6	7.0
61	14	139	1	1	1	1X	1X	10	0	0	0	0	0	0	0	70	13	13	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.3
61	14	140	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	5.0	5.9	6.7	7.6	8.5	9.3	10.3
61	14	141	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.8
61	14	142	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	5.0	6.3
61	14	143	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.6	6.1	7.2	8.1	8.8	9.4	10.1	11.2
61	14	144	1	1	1	13	13	13	0	0	0	0	0	0	0	0	0	0	6.0	6.2	6.4	6.6	6.8	7.0	7.2	7.4	7.6	8.0
61	14	145	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	.0	3.9	5.0	5.2	6.3	7.5	7.9	8.5	8.9	9.3
61	14	146	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.3
61	14	147	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.3	7.1
61	14	148	2	2	2	41	43	43	0	66	0	0	30	0	30	30	30	30	28.6	29.2	30.0	30.5	30.9	31.1	31.3	31.5	31.7	32.0
61	14	149	2	2	2	33	34	34	0	65	10	0	0	0	30	0	0	52	18.6	19.0	19.4	19.7	19.7	19.8	19.9	20.0	20.0	20.0
61	14	150	2	2	2	43	44	43	0	64	52	60	0	3	0	0	0	0	27.7	27.9	28.0	28.4	28.5	28.6	28.7	28.8	29.1	29.3
61	14	151	2	2	2	32	33	33	0	0	0	0	0	0	0	0	0	0	25.2	25.5	25.9	26.3	26.5	26.7	26.8	27.0	27.2	27.5
61	14	152	2	2	2	34	34	34	0	0	0	0	0	30	30	30	30	33	25.6	25.7	25.7	25.8	25.8	25.9	25.9	25.9	25.9	26.0
61	14	153	1	1	1	21	22	22	0	0	0	0	0	0	30	30	30	30	14.3	14.9	15.6	16.2	16.8	17.2	17.4	17.7	18.1	18.6
61	14	154	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.2	6.6
61	14	155	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.1	6.4
61	14	156	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.2
61	14	157	2	2	2	34	34	34	0	0	0	0	0	0	0	30	0	0	20.9	21.1	21.3	21.4	21.5	21.5	21.5	21.6	21.6	21.6
61	14	158	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	14	159	1	7	1	21	22	22	0	0	0	0	0	0	0	0	0	52	18.4	19.0	19.6	20.2	20.7	20.9	21.3	21.6	22.0	22.7
61	14	160	1	1	1	20	21	21	0	0	0	0	0	0	0	0	0	0	17.3	18.1	19.0	19.8	20.5	21.1	21.5	22.0	22.9	23.9
61	14	161	1	1	1	21	22	21	0	0	0	0	0	0	0	0	0	0	20.3	20.9	21.5	22.1	22.6	23.2	23.7	23.7	24.6	25.6
61	14	162	1	1	1	22	22	22	0	0	0	0	0	0	0	0	0	0	15.5	16.0	16.4	16.9	17.0	17.6	17.7	18.0	18.3	18.8
61	14	163	1	1	1	22	22	22	0	0	0	0	31	0	0	32	0	0	18.6	19.0	19.5	20.0	20.3	20.6	20.9	21.2	21.5	22.0
61	14	164	2	2	2	32	32	30	0	0	0	0	0	0	0	0	30	0	26.3	26.8	27.3	27.8	28.2	28.7	28.8	29.2	29.6	32.0
61	14	165	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	5.0	7.0
61	14	166	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.3	7.3
61	14	167	2	2	2	32	34	34	0	3	0	0	0	0	0	60	64	0	29.2	29.5	29.9	30.1	30.4	30.5	30.5	30.6	30.6	30.6
61	14	168	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.8	4.4	5.0	5.6	7.1
61	14	169	1	1	1	1X	1X	1X	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	.0	4.0	6.0
61	14	170	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	5.0	6.0	8.0
61	14	171	1	1	1	1X	1X	10	0	0	0	0	0	0	0	70	13	13	.0	.0	.0	.0	.0	.0	4.2	4.9	5.5	7.0
61	14	172	2	2	2	42	4X	4X	0	9	65	0	0	0	97	0	0	0	33.0	33.4	34.5	34.7	34.7	34.8	34.8	.0	.0	.0
61	14	173	2	2	2	33	3X	3X	0	0	52	60	0	0	97	0	0	0	23.3	23.5	23.6	23.8	24.0	24.1	24.1	.0	.0	.0
61	14	174	1	1	1	20	2X	2X	0	0	0	0	0	0	97	0	0	0	16.7	17.5	18.2	19.1	19.9	20.6	20.6	.0	.0	.0
61	14	175	1	1	1	10	1X	2X	0	0	0	0	0	0	97	0	0	0	10.3	11.0	11.4	12.4	13.1	14.0	14.0	.0	.0	.0
61	14	176	1	1	1	20	2X	2X	0	0	0	0	0	0	97	0	0	0	16.3	17.2	17.9	18.9	19.9	20.9	20.9	.0	.0	.0
61	14	177	2	2	2	44	44	44	0	0	0	0	0	0	30	0	0	92	31.4	31.5	31.5	31.5	31.5	31.6	31.6	31.6	31.7	31.7
61	14	178	2	2	2	34	34	3X	0	64	52	60	52	0	9	0	90	0	28.2	28.3	28.3	28.3	28.5	28.5	28.5	28.6	28.6	.0
61	14	179	1	1	1	21	21	24	0	0	0	0	0	0	0	0	0	92	21.4	22.1	22.9	23.6	24.1	24.7	25.3	25.6	26.0	26.0
61	14	180	2	2	2	34	34	34	0	0	52	0	0	0	0	0	0	92	36.2	36.3	36.4	36.5	36.6	36.7	36.7	36.8	36.8	36.8
61	14	181	2	2	2	44	44	4X	0	0	52	0	0	60	0	92	0	0	37.1	37.1	37.1	37.1	37.2	37.2	37.2	37.2	.0	.0
61	14	182	1	1	1	12	1X	1X	0	0	0	0	0	99	0	0	0	0	.0	3.7	4.1	4.5	4.8	4.8	.0	.0	.0	.0
61	14	183	2	2	2	34	3X	3X	0	9	52	60	90	0	0	0	0	0	13.3	13.3	13.3	13.5	13.5	.0	.0	.0	.0	.0
61	14	184	1	1	1	1X	10	13	0	0	0	0	0	0	0	0	0	92	.0	.0	.0	.0	4.3	5.4	6.3	7.1	7.8	7.8
61	14	185	2	2	2	44	4X	4X	24	24	24	24	24	90	0	0	0	0	36.2	36.3	36.3	36.3	36.4	36.4	.0	.0	.0	.0
61	14	186	1	1	1	10	1X	1X	0	0	0	0	0	0	92	0	0	0	.0	4.0	4.9	5.6	6.3	6.8	6.9	.0	.0	.0
61	14	187	1	1	1	10	14	1X	0	0	0	0	0	0	0	92	0	0	.0	3.8	4.7	5.4	6.0	6.3	6.4	6.4	.0	.0

TABLE 1.15:

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	16	1	1	1	1	13	12	12	0	0	0	0	0	0	0	0	0	0	4.0	4.3	4.6	4.7	5.0	5.1	5.3	5.9	6.2	6.8
61	16	2	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.4	4.8	5.2	5.6	6.4
61	16	3	1	1	1	1X	11	12	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	3.8	4.1	5.0	5.5	5.9	6.3	7.1
61	16	4	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	4.7	5.2	5.6	6.0	6.4	6.8	7.2
61	16	5	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	4.1	4.5	4.9	5.3	5.7	6.1	6.8
61	16	6	1	1	1	1X	12	11	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	.0	4.0	4.5	4.9	5.4	6.0	7.2
61	16	7	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	4.6	5.0	5.4	6.2
61	16	8	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.8	4.3	4.9	5.5	6.1
61	16	9	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.6	5.2	5.8	6.7
61	16	10	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.2	5.0	5.5	6.0	6.5	7.2	8.2
61	16	11	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.0	5.4	5.8	6.1	6.4	6.7	7.0	7.4	7.8	8.5
61	16	12	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	33	.0	.0	.0	.0	.0	4.1	4.9	5.7	5.6	6.2
61	16	13	1	1	1	1X	12	11	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	4.2	4.6	5.1	5.5	5.9	7.0	7.7
61	16	14	1	1	1	1X	11	12	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	4.0	4.7	5.3	6.0	6.7	7.1	7.9
61	16	15	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	.0	.0	.0	3.9	4.3	5.3	6.5
61	16	16	1	1	1	1X	12	11	0	0	0	0	0	0	0	0	0	33	.0	.0	4.2	4.6	5.0	5.4	5.8	6.2	6.9	7.9
61	16	17	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.3	5.0	5.7	6.4	6.8	8.0
61	16	18	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.1	4.6	5.0	5.5	5.9	6.4	6.8	7.3	7.7	8.6
61	16	19	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	3	3	.0	.0	.0	3.9	4.4	5.1	5.7	6.2	6.8	8.0
61	16	20	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	14	14	.0	.0	.0	.0	.0	4.2	4.6	5.3	6.0	7.2

61	16	21	0	1	1	44	1X	11	0	0	0	0	0	0	0	0	14	14	.0	.0	.0	.0	.0	.0	4.3	5.0	5.7	6.9
61	16	22	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.1	4.7	5.3	6.0	7.0
61	16	23	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	4.8	5.5	6.5	8.0
61	16	24	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.3	4.9	5.4	5.9	6.4	7.4
61	16	25	1	1	1	1X	1X	12	0	0	0	0	0	0	0	33	33	33	.0	.0	.0	.0	.0	3.9	4.4	4.8	5.2	6.2
61	16	26	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	4.2	5.0	5.8	6.9
61	16	27	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	33	33	.0	.0	.0	.0	.0	.0	.0	4.2	4.8	6.1
61	16	28	1	1	1	10	10	21	0	0	0	0	0	0	0	0	0	0	4.0	4.7	6.4	8.0	9.4	10.5	11.3	12.2	13.0	14.2
61	16	29	1	1	1	1X	11	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	4.7	5.2	6.0	6.9	8.2
61	16	30	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	4.1	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1	9.1
61	16	31	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.6	5.9	6.2	6.5	6.8	7.1	7.4	7.7	8.2	9.0
61	16	32	1	1	1	12	13	12	0	0	0	0	0	0	0	0	0	0	3.8	4.0	4.2	4.6	5.0	5.2	5.4	5.6	6.3	7.0
61	16	33	1	1	1	10	11	12	0	35	2	14	0	0	0	0	0	0	4.4	5.2	5.7	6.7	7.6	8.2	8.6	9.3	9.9	10.6
61	16	34	1	1	1	10	12	12	0	0	0	0	0	0	0	0	0	0	5.2	5.9	6.8	7.4	8.0	8.4	8.6	8.8	9.2	9.7
61	16	35	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.7	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.0	8.7
61	16	36	1	1	1	10	11	12	0	9	2	0	0	0	0	0	0	11	5.7	6.5	7.3	8.1	9.0	9.4	10.0	10.7	11.1	11.6
61	16	37	1	1	1	13	12	12	0	0	0	0	0	0	0	0	0	0	4.0	4.6	4.9	5.2	5.4	5.6	5.8	6.2	6.5	7.0
61	16	38	1	1	1	11	12	13	0	0	52	0	0	0	0	0	0	0	5.4	6.1	6.9	7.5	8.1	8.5	8.7	9.1	9.4	9.7
61	16	39	1	1	1	12	14	14	0	0	0	0	0	0	0	0	0	0	4.7	5.0	5.5	5.7	5.8	6.0	6.1	6.2	6.3	6.5
61	16	40	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	5.5	5.8	6.1	6.4	6.7	7.0	7.3	7.6	7.9	8.5
61	16	41	1	2	2	11	21	22	0	0	0	0	0	0	0	0	0	0	9.6	10.2	10.9	11.7	12.1	12.8	13.2	13.7	14.2	14.5
61	16	42	1	1	1	11	11	12	0	0	0	0	0	0	0	0	0	0	4.2	4.7	5.3	5.8	6.4	6.9	7.5	8.0	8.5	9.1
61	16	43	1	1	1	12	13	13	0	0	0	0	0	0	0	0	0	35	.0	3.8	4.2	4.7	5.2	5.5	5.7	5.9	6.1	6.5
61	16	44	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.9	4.3	4.5	4.8	5.1	5.4	6.0
61	16	45	1	1	1	13	14	14	0	0	0	0	0	0	0	0	0	0	5.2	5.4	5.7	5.9	6.0	6.1	6.1	6.1	6.1	6.2
61	16	46	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	4.9	5.6	6.2	7.0	7.6	8.0	8.4	8.8	9.1	9.6
61	16	47	1	1	1	11	12	14	0	0	0	0	0	0	0	0	0	0	3.8	4.1	4.8	5.5	6.0	6.5	7.0	7.2	7.4	7.5
61	16	48	1	1	1	11	14	14	0	0	0	0	0	0	0	0	0	0	5.0	5.4	6.1	6.5	7.0	7.3	7.3	7.3	7.4	7.5
61	16	49	1	1	1	12	12	12	0	0	0	0	0	0	0	0	0	0	4.2	5.1	5.5	5.8	6.2	6.5	6.9	7.2	7.6	8.3
61	16	50	1	1	1	11	12	12	0	0	0	0	0	0	0	0	0	0	4.7	5.3	6.0	6.5	7.1	7.5	8.5	8.2	8.7	9.5
61	16	51	1	1	1	11	12	13	0	0	0	0	0	0	0	0	0	4	.0	3.8	4.6	5.2	5.8	6.2	6.4	6.5	6.9	7.3
61	16	52	1	1	1	1X	1X	12	0	0	0	0	0	0	0	33	33	35	.0	.0	.0	.0	.0	3.8	4.2	5.0	5.2	6.0
61	16	53	2	2	2	44	43	42	0	64	0	0	0	0	0	13	0	14	39.1	39.2	39.4	39.4	39.4	39.5	39.6	39.8	39.9	40.8
61	16	54	1	1	1	12	14	13	0	0	0	0	0	0	0	0	0	0	.0	4.0	4.2	4.6	5.0	5.2	5.2	5.4	5.6	6.0
61	16	55	1	1	1	13	14	13	0	0	0	0	0	0	0	0	0	0	4.0	4.6	4.9	5.0	5.1	5.2	5.3	5.5	5.7	6.2
61	16	56	1	1	1	11	11	12	0	0	0	0	0	0	0	0	0	0	.0	4.1	4.8	5.5	6.0	6.5	7.0	7.5	8.0	8.8
61	16	57	2	2	2	43	43	43	0	65	52	0	0	0	30	0	0	30	38.5	38.7	39.0	39.2	39.4	39.7	39.8	39.9	40.0	40.4
61	16	58	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.9	4.8	5.8	6.8	7.8	9.8
61	16	59	2	2	2	43	44	44	0	0	0	0	0	0	62	0	0	52	31.9	32.1	32.3	32.5	32.7	32.8	32.8	32.8	32.8	32.8
61	16	60	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.7	4.6	5.6	6.6	7.6	9.6
61	16	61	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	14	.0	.0	.0	.0	.0	.0	3.7	4.3	5.2	6.2
61	16	62	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	3.5	4.6	5.8	6.8	7.8	8.6	9.2	9.9	10.5	11.4
61	16	63	1	1	2	10	10	20	0	14	0	0	0	0	0	0	0	0	4.1	5.4	6.8	8.2	9.4	10.2	10.9	11.9	12.7	14.0
61	16	64	1	1	1	10	11	12	0	33	0	0	0	0	0	0	0	0	5.3	6.1	6.9	7.7	8.5	9.1	9.6	10.1	10.7	11.4
61	16	65	1	2	2	10	21	22	0	33	0	0	0	0	0	0	30	0	8.7	9.5	10.4	11.1	11.8	12.7	13.1	13.9	14.3	15.2
61	16	66	1	1	1	10	11	12	0	0	0	0	0	0	0	0	0	0	5.1	5.9	6.8	7.5	8.2	8.8	9.2	9.7	10.2	10.8
61	16	67	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.6	4.3	5.0	5.8	6.3	7.3
61	16	68	2	2	2	21	22	22	0	0	0	0	0	0	0	0	0	0	22.0	22.5	22.9	23.5	24.0	24.5	24.9	25.3	25.7	26.5
61	16	69	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.0	5.9	7.7
61	16	70	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	5.0	5.8	6.5	7.8
61	16	71	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.9	4.6	5.4	6.1	6.9	7.6	9.1
61	16	72	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.9	6.8
61	16	73	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.2	4.6	5.2	5.6	6.3
61	16	74	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.9	4.4	5.2	6.1	8.1
61	16	75	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	5.1	6.2	7.2	7.7	8.4	9.0	10.4
61	16	76	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.5	5.2	5.9	6.6	7.3	8.0	9.4
61	16	77	1	1	1	1X	10	10	0	0	0	0	0	0	0	0	0	0	.0	.0	4.2	5.5	6.5	7.4	8.5	8.7	9.4	10.8
61	16	78	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	.0	.0	4.0	4.7	5.6	6.8
61	16	79	2	2	2	20	22	21	0	0	0	0	0	0	0	0	0	0	16.3	17.1	17.9	18.6	19.4	19.9	20.3	20.6	21.5	22.4
61	16	80	2	2	2	22	23	23	0	3	0	0	0	0	0	0	0	0	14.1	14.5	15.0	15.3	15.7	15.9	16.1	16.4	16.7	17.1
61	16	81	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.3	5.1	7.1
61	16	82	2	2	2	23	23	24	0	4	0	0	0	0	0	0	0	14	17.8	18.1	18.5	18.6	18.8	19.1	19.3	19.3	19.4	19.6
61	16	83	1	1	2	10	11	21	0	0	0	0	0	0	0	0	0	0	4.8	5.8	7.0	7.9	8.8	9.5	10.2	10.9	11.6	12.7
61	16	84	2	2	2	22	24	23	0	3	0	0	32	0	0	0	0	0	16.5	16.8	17.0	17.4	17.8	17.9	18.0	18.0	18.5	18.7
61	16	85	2	2	2	22	23	22	0	0	0	0	0	0	0	0	0	0	19.7	20.1	20.4	20.9	21.3	21.6	21.7	21.9	22.3	22.7
61	16	86	2	2	2	44	44	44	0	0	0	0	0	0	0	0	0	0	30.1	30.2	30.2	30.3	30.5	30.7	30.7	30.7	30.8	30.8
61	16	87	2	2	2	32	34	34	0	0	0	0	0	0	0	0	0	0	29.4	29.7	30.0	30.3	30.6	30.8	30.8	30.9	31.0	31.2
61	16	88	2	2	2	33	34	34	0	0	0	0	0	13	30	0	0	0	23.6	23.8	23.9	24.1	24.3	24.4	24.4	24.5	24.5	24.6
61	16	89	2	2	2	32	34	34	0	0	0	0	0	0	0	0	0	0	31.7	32.0	32.3	32.6	32.9	32.9	32.9	33.0	33.0	33.2
61	16	90	2	2	2	33	33	34	0	64	0	0	0	0	30	30	30	0	25.5	25.7	25.9	26.1	26.4	26.6	26.6	26.8	27.0	27.1
61	16	91	2	2	2	33	34	34	0	4	64	0	0	13	30	30	0	0	21.6	21.8	22.0	22.1	22.3	22.3	22.4	22.5	22.5	22.8
61	16	92	2	2	2	32	33	32	0	9	3	0	0	0	30	0	0	14	20.5	20.8	21.2	21.4	21.8	22.0	22.2	22.4	22.8	23.3
61	16	93	2	2	2	33	34	33	0	0	0	0	0	0	31	30	30	0	25.9	26.1	26.4	26.5	26.7	26.8	26.9	26.9	27.0	27.3
61	16	94	2	2	2	32	33	33	0	13	0	0	0	0	30	0	30	14	23.5	23.9	24.2	24.5	25.0	25.2	25.4	25.6	25.7	26.3
61	16	95	2	2	2	33	34	33	0	3	0	0	0	0	30	31	30	0	24.8	25.1	25.4	25.5	25.9	26.0	26.0	26.2	26.4	26.8
61	16	96	2	2	2	43	43	43	0	67	0	0	0	0	0	30	0	3	26.8	27.0	27.3	27.4	27.7	27.9	28.0	28.2	28.3	28.7
61	16	97	2	2	2	42	42	42	0	0	0	0	0	0	4	30	0	0	22.2	22.5	22.7	23.0	23.3	23.7	23.7	24.2	24.4	25.1
61	16	98	2	2	2	43	44	43	0	9	0	0	0	0	0	0	30	13	17.0	17.2	17.4	17.5	17.8	17.9	17.9	18.0	18.2	18.6
61	16	99	2	2	2	32	33	32	0	0	0	0	0	0	0	0	0	0	22.2	22.5	22.8	23.0	23.4	23.7	23.8	24.1	24.5	25.1
61	16	100	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.5	6.5
61	16	101	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	4.3	5.0	5.7	6.3	6.9	7.6	8.4	9.6
61	16	102	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.1	5.0	5.9	7.6
61	16	103	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.8	6.3
61	16	104	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.9	4.4	4.9	5.4	6.3
61	16	105	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.7	5.5	6.5
61	16	106	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	5.0	6.7
61	16	107	1	1	2	10	10	21	0	0	0	0	0	0	0	0	0	0	.0	4.3	5.9	7.0	8.0	10.6	11.3	12.0	12.7	13.9
61	16	108	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.6	4.3	6.0
61	16	109	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.4	5.3	6.1	7.0	7.9	8.6	9.5
61	16	110	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	9.0
61	16	111	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	3	.0	.0	3.7	4.6	5.5	6.4	6.6	7.0	7.4	8.5
61	16	112	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.4	4.9	6.7
61	16	113	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	3.8	4.2	4.8	5.2	5.6	6.0	6.9
61	16	114	1	1	1	10	10	11	0	0	0	0	0	0	0	0	0	0	.0	3.9	5.2	6.5	7.8	9.1	9.7	10.4	11.0	12.0
61	16	115	1	1	1	12	13	12	0	0	0	0	0	0	0	0	0	0	5.8	6.0	6.3	6.5	6.8	7.0	7.3	7.5	7.8	8.3
61	16	116	1	1	1	11	11	11	0	0	0	0	0	0	0	0	0	0	.0	3.6	4.2	4.8	5.4	6.0	6.6	7.2	7.8	9.0
61	16	117	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	5.0	5.8	7.3
61	16	118	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.6	4.3	5.2	5.8	7.5
61	16	119	1	1	1	1X	10	11	0	0	0	0	0	0	0	0	0	0	.0	.0	3.6	4.7	6.1	7.2	8.0	8.9	9.6	10.8
61	16	120	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.8	6.5

```
61  16  121   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0  3.6  4.4  5.4  6.4  8.4
61  16  122   1 1 1   1X 10 11   0  0  0  0  0  0  0  0  0  0     .0   .0  4.0  4.9  6.0  7.0  7.7  8.6  9.4 10.4
61  16  123   1 1 1   11 11 11   0  0  0  0  0  0  0  0  0  0    4.1  4.6  5.1  5.6  6.1  6.6  7.1  7.6  8.2  9.1
61  16  124   1 1 1   1X 10 11   0  0  0  0  0  0  0  0  0  0     .0   .0  3.9  5.1  6.3  7.6  8.4  9.2  9.9 11.0
61  16  125   2 2 2   20 22 21   0  0  0  0  0  0  0  0  0  0   12.9 14.1 15.4 16.7 17.6 18.2 18.7 19.0 19.5 20.6
61  16  126   1 1 1   12 12 12   0  0  0  0  0  0  0  0  0  0    4.4  4.8  5.2  5.6  6.0  6.4  6.8  7.2  7.6  8.4
61  16  127   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  2     .0   .0   .0   .0   .0   .0  3.7  4.3  5.2  7.0
61  16  128   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.0  5.0  7.2
61  16  129   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  3     .0   .0   .0   .0   .0   .0   .0  4.1  5.0  6.5
61  16  130   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.2  4.7  6.6

61  16  131   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.2  5.0  5.6  7.4
61  16  132   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.1  4.8  6.4
61  16  133   1 1 1   10 11 12   0 35  0  0  0  0  0  0  0 14    4.0  5.2  6.7  7.7  8.8  9.5 10.0 10.6 11.2 11.8
61  16  134   1 1 1   12 13 13   0  0  0  0  0  0  0  0  0  0    5.8  6.0  6.3  6.5  6.8  7.0  7.2  7.4  7.6  8.0
61  16  135   2 2 2   22 22 22   0 33  0  0  0  0  0  0  0  0   14.3 14.8 15.4 15.7 16.2 16.5 16.6 17.2 17.5 18.2
61  16  136   2 2 2   21 22 22   0 33  0  0  0  0  0  0  0  0   14.5 15.1 15.7 16.2 16.8 17.2 17.6 18.0 18.6 19.2
61  16  137   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.1  4.9  6.9
61  16  138   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0 14     .0   .0   .0   .0   .0   .0  4.0  4.8  5.8  7.8
61  16  139   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0  3.6  4.2  4.9  5.7  7.5
61  16  140   1 1 2   10 11 22   0  0  0  0  0  0  0  0  0  0    5.6  6.6  7.7  8.7  9.6 10.3 10.9 11.6 12.1 13.0

61  16  141   1 1 1   10 12 12   0 33  0  0  0 14  0  0  0  0    4.7  5.5  6.4  7.0  7.8  8.2  8.7  9.1  9.7 10.3
61  16  142   1 1 1   1X 10 11   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0  4.0  4.7  5.2  6.5  7.8  8.5
61  16  143   1 1 2   11 12 22   0 35  0  0  0 14  0  0  0  0    8.6  9.3 10.1 10.7 11.3 11.7 12.0 12.3 12.7 13.3
61  16  144   1 1 1   10 11 12   0  0  0  0  0  0  0  0  0  0    4.6  5.4  6.2  7.1  7.8  8.4  9.0  9.6 10.2 11.0
61  16  145   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  4.0  4.6  5.4  7.8
61  16  146   1 1 1   1X 11 11   0  0  0  0  0  0  0  0  0  0     .0   .0   .0  3.9  4.3  4.7  5.3  5.8  6.4  7.5
61  16  147   1 2 2   10 21 22   0 33  0  0  0  0  0  0  0  0    8.4  9.4 10.7 11.6 12.5 13.1 13.5 14.3 14.8 15.6
61  16  148   2 1 2   21 22 23   0  0  0  0  0  0  0  0  0 62   27.4 28.0 28.5 29.2 29.8 30.3 30.5 31.0 31.4 31.7
61  16  149   1 1 2   10 11 21   0 64  9  0  0 14  0  0  0 33    7.7  8.7 10.0 10.7 11.5 12.1 12.9 13.5 14.1 15.0
61  16  150   1 1 1   1X 1X 1X   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0   .0  4.1  6.0

61  16  151   1 1 1   10 11 11   0  0  0  0  0  0  0  0  0  0     .0  4.2  5.3  6.5  7.4  7.9  8.7  9.2  9.7 10.7
61  16  152   1 1 2   10 10 21   0  0  0  0  0  0  0  0  0  0    5.2  6.4  7.7  8.9  9.9 10.8 11.4 12.3 13.0 13.9
61  16  153   1 2 2   20 21 21   0 33  0  0  0  0  0  0  0  0   10.6 11.7 13.0 14.0 14.9 15.4 16.2 16.5 17.0 18.0
61  16  154   1 1 2   10 10 21   0  0  0  0  0  0  0  0  0  0    5.2  6.4  7.9  9.0 10.1 10.9 11.7 12.4 13.2 14.2
61  16  155   1 1 1   1X 11 11   0  0  0  0  0  0  0  0  0  0     .0   .0  4.1  4.7  5.3  5.9  6.5  7.1  7.7  8.9
61  16  156   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  3.7  4.3  6.1
61  16  157   2 2 2   44 44 44   0 65  0  0  0  0  0  0  0 11   19.8 20.0 20.2 20.2 20.3 20.3 20.3 20.5 20.5 20.7
61  16  158   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  3.9  4.6  6.4
61  16  159   2 2 2   34 34 34   0  4  0  0  0  0  0  0 30  4   13.2 13.3 13.5 13.6 13.7 13.8 13.8 13.9 13.9 13.9
61  16  160   2 2 2   33 33 34   0  0  0  0  0  0  0  0 30  0   20.6 20.8 21.1 21.3 21.5 21.8 21.8 22.0 22.1 22.3

61  16  161   2 2 2   32 33 33   0  2  0  0  0  0  0  0  0  0   10.3 10.6 11.0 11.3 11.6 11.7 11.8 12.1 12.3 12.7
61  16  162   2 2 2   33 34 34   0  0  0  0  0  0  0  0  0 30   21.7 21.9 22.1 22.2 22.4 22.5 22.6 22.6 22.7 22.8
61  16  163   1 1 2   10 11 21   0  0 33  0  0  0  0  0  0  2    6.6  7.5  8.2  9.2 10.1 10.8 11.4 12.2 12.9 13.7
61  16  164   1 1 1   10 11 12   0  0  0  0  0  0  0  0  0  0     .0  4.1  5.0  5.8  6.5  7.0  7.7  8.2  8.7  9.6
61  16  165   2 2 2   4X 4X 4X   0  0  0 99  0  0  0  0  0  0   24.0 24.0 24.0 24.0   .0   .0   .0   .0   .0   .0
61  16  166   1 1 1   12 1X 1X   0  0  0  0  0  0 92  0  0  0    5.1  5.3  5.7  6.1  6.5  6.6  6.6   .0   .0   .0
61  16  167   1 1 1   12 1X 1X   0  0  0  0  0  0 92  0  0  0    4.6  5.1  5.6  6.1  6.5  6.9  6.9   .0   .0   .0
61  16  168   1 1 1   11 1X 1X   0  0  0  0  0  0 92  0  0  0     .0  3.6  4.2  4.9  5.4  6.0  6.0   .0   .0   .0
61  16  169   1 1 1   10 1X 1X   0  0  0  0  0  0 92  0  0  0     .0  3.7  4.7  5.6  6.4  7.0  7.0   .0   .0   .0
61  16  170   1 1 1   11 12 11   0  0  0  0  0  0  0  0  0  0    5.0  5.4  6.1  6.5  7.0  7.3  7.3  7.8  8.3  9.5

61  16  171   1 1 1   13 13 13   0  0  0  0  0  0  0  0  0  0    6.3  6.5  6.7  6.9  7.1  7.3  7.5  7.7  7.9  8.3
61  16  172   1 1 1   11 11 12   0  0  0  0  0  0  0  0  0  0    7.1  7.6  8.0  8.6  9.2  9.7 10.2 10.8 11.2 11.9
61  16  173   2 2 2   32 34 33   0  0  0  0  0  0  0  0  0  0   22.5 22.9 23.2 23.4 24.2 23.7 23.9 23.9 24.1 24.3
61  16  174   2 2 2   33 32 32   0  0  0  0  0  0  0  0  0  0   22.8 23.1 23.5 23.8 23.9 24.4 24.5 24.8 25.2 25.8
61  16  175   2 2 2   32 33 33   0  3  0  0  0  0  0  0 30  0    8.9  9.2  9.5  9.8 10.1 10.3 10.4 10.6 10.8 11.2
61  16  176   2 2 2   32 32 32   0  0  0  0  0  0  0  0 30 30   12.6 13.0 13.6 13.9 14.3 14.6 14.9 15.2 15.5 16.1
61  16  177   2 2 2   34 34 34   0 73  0  0  0  0  0  0 30  0   10.7 10.7 10.7 10.7 10.7 10.7 10.7 10.8 10.9 11.0
61  16  178   2 2 2   32 33 33   0  0  0  0  0  0  0  0 30 30   23.6 24.0 24.5 24.8 25.2 25.5 25.7 25.9 26.2 26.5
61  16  179   2 2 2   34 34 34   0  0  0  0  0  0  0  0  0 73   10.0 10.1 10.2 10.3 10.4 10.5 10.5 10.6 10.7 10.7
61  16  180   2 2 2   33 34 34   0  0  0  0  0  0  0  0  0  0   19.6 19.8 19.9 20.1 20.3 20.3 20.3 20.5 20.7 20.8

61  16  181   2 2 2   33 34 34   0  0  0  0  0 14 43 31 30  0   16.4 16.6 16.9 17.1 17.1 17.2 17.3 17.3 17.3 17.3
61  16  182   2 2 2   43 44 43   0 64  0  0  0  0  0  0  0  0   30.1 30.3 30.5 30.7 30.9 31.1 31.1 31.2 31.3 31.6
61  16  183   2 2 2   33 32 34   0 64 52  0  0 30  0  0  0  0   19.3 19.6 19.9 20.3 20.4 20.4 21.1 21.3 21.6 21.7
61  16  184   2 2 2   44 44 43   0 64  0  9  0 13  0  0  0  0   13.7 13.8 13.9 14.0 14.1 14.2 14.2 14.3 14.8 15.0
61  16  185   2 2 2   32 33 33   0 64  0  0  0  0  0  0  0  0   19.5 19.8 20.1 20.5 20.7 21.1 21.4 21.4 21.7 21.9
61  16  186   2 2 2   33 33 34   0  0  0  0  0  0  0  0  0  0   28.6 28.8 29.0 29.2 29.4 29.5 29.6 29.8 30.0 30.1
61  16  187   2 2 2   32 33 33   0  0  0  0  0  0 30  3  0 30   29.6 29.9 30.2 30.4 30.7 31.0 31.1 31.4 31.6 31.8
61  16  188   2 2 2   33 32 32   0  0  0  9  0  0  0  0  0  0   13.7 13.9 14.2 14.5 14.5 15.1 15.3 15.5 15.9 16.5
61  16  189   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0  3.6  4.3  5.1  6.6
61  16  190   1 1 1   10 11 12   0  0  0  0  0  0  0  0  0  0    3.6  4.4  5.3  6.1  6.8  7.3  7.8  8.4  8.8  9.6

61  16  192   2 2 2   34 34 34   0  0  0  0  0  0  0  0  0 14   13.8 13.9 14.0 14.1 14.2 14.4 14.4 14.5 14.6 14.7
61  16  193   2 2 2   32 32 33   0  0 52  0  0  0  0  0  0  0   18.6 18.9 19.2 19.5 19.8 20.0 20.2 20.6 20.8 21.4
61  16  194   2 2 2   33 34 34   0  0  0  0  0  0  0  0  0  0   18.9 19.1 19.3 19.4 19.6 19.7 19.7 19.8 19.9 20.1
61  16  195   2 2 2   33 34 34   0  4  0  0  0  0  0  0  0  0    7.8  8.0  8.2  8.4  8.6  8.7  8.8  9.0  9.2  9.3
61  16  196   2 2 2   33 33 33   0  0  0  9  0  3  0  0  0  0    9.2  9.4  9.6  9.7  9.9 10.1 10.1 10.3 10.5 10.9
61  16  197   2 2 2   30 31 31   0  0  0  0  0  0  0  0  0  0   15.8 16.2 16.8 17.6 18.3 19.0 19.5 20.0 20.7 21.8
61  16  198   2 2 2   31 33 32   0  0 52  0  0  0  0 30 30  0   17.1 17.6 18.2 18.6 19.2 19.6 19.7 19.9 20.3 20.7
61  16  199   2 2 2   33 33 33   0  0 52  0  0  0  0 31 30  0   19.3 19.5 19.8 20.0 20.2 20.3 20.5 20.7 20.8 21.1
61  16  200   2 2 2   33 34 33   0  0  0  0 32  0  0  0  0  0   25.6 25.7 25.8 25.9 26.1 26.1 26.1 26.2 26.3 26.6

61  16  201   2 2 2   33 33 33   0  0  0  0  0  0  0  0  0 30   24.5 24.7 24.9 25.0 25.3 25.4 25.5 25.8 26.0 26.5
61  16  202   2 2 2   34 34 34   0  2  0  0  0  0  0  4  0  0   18.8 18.8 18.8 18.8 18.9 18.9 19.0 19.0 19.0 19.2
61  16  203   2 2 2   33 33 33   0  0  0  0  0  0  0  0  0  0   22.2 22.4 22.5 22.7 22.9 23.2 23.3 23.6 23.8 24.3
61  16  204   2 2 2   32 33 32   0  0  0  0  0  0  0  0 30 30   19.2 19.5 19.8 20.0 20.3 20.5 20.7 20.8 21.2 21.6
61  16  205   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  3.9  4.8  6.9
61  16  206   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  3.7  4.4  6.1
61  16  207   2 2 2   33 32 33   0  3  0  0  0  0 30 30  0 14   24.7 24.9 25.2 25.4 25.4 25.9 26.0 26.2 26.4 26.7
61  16  208   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  4.2  4.8  6.5
61  16  209   1 1 0   11 1X 44   0  0  0  0  0  0 92  0  0  0     .0  3.6  4.3  5.0  5.5  5.9  5.9   .0   .0   .0
61  16  210   1 1 1   1X 1X 10   0  0  0  0  0  0  0  0  0  0     .0   .0   .0   .0   .0   .0   .0  3.7  4.4  6.3

61  16  211   1 1 1   12 12 12   0  0  0  0  0  0  0  0  0  0    4.8  5.2  5.7  6.1  6.5  7.0  7.4  7.8  8.3  9.1
61  16  212   2 2 2   34 3X 3X   0  0  9 45 98  0  0  0  0  0   14.8 14.8 14.9 15.0 15.0   .0   .0   .0   .0   .0
61  16  213   2 2 2   34 3X 3X   0  0 52  0 92  0  0  0  0  0   25.8 25.8 26.0 26.2 26.2   .0   .0   .0   .0   .0
61  16  214   2 2 2   4X 4X 4X   0 60 52 92  0  0  0  0  0  0   30.5 30.5 30.5 30.5   .0   .0   .0   .0   .0   .0
61  16  215   2 2 2   44 4X 4X   0  3  0  0  0 60 90  0  0  0   28.2 28.3 28.3 28.3 28.3 28.4 28.4   .0   .0   .0
61  16  216   2 2 2   44 4X 4X   0  0  0  0  0  9 92  0  0  0   23.9 23.9 24.0 24.1 24.1 24.1 24.1   .0   .0   .0
61  16  217   2 2 2   44 44 4X   0  0  0  0  0  0 31 92  0  0   28.5 28.5 28.5 28.5 28.5 28.5 28.5 28.5   .0   .0
61  16  218   2 2 2   33 33 34   0  0  0  0  0  0 30  0  0 90   28.3 28.3 28.5 28.7 28.9 29.2 29.4 29.5 29.8 29.8
61  16  219   2 2 2   42 44 4X   0  0  0  0  0  0 30  0 91  0   39.5 39.8 40.1 40.4 40.7 41.0 41.0 41.0 41.0   .0
61  16  220   2 2 2   4X 4X 4X   0 52 92  0  0  0  0  0  0  0   30.8 30.8 30.8   .0   .0   .0   .0   .0   .0   .0
```

61	16	221	1	1	1	12	1X	1X	0	11	0	0	49	0	0	0	0	0	5.2	5.7	6.3	6.7	6.7	.0	.0	.0	.0	.0
61	16	222	2	2	2	34	34	34	0	0	0	0	0	0	30	0	0	92	13.5	13.[illegible]	13.7	13.8	13.9	13.9	13.9	13.9	13.9	14.0
61	16	223	2	2	2	34	3X	3X	0	9	2	0	92	0	0	0	0	0	12.4	12.4	12.4	12.4	12.4	.0	.0	.0	.0	.0
61	16	224	1	1	1	1X	10	1X	0	0	0	0	0	0	0	0	91	0	.0	.0	3.6	4.2	5.3	6.2	7.0	7.8	7.8	.0

TABLE 1.1 :

PLOT NO.	SUB PLOT NO.	TREE NO.	AGE CLASS			AGE-VIGOR			TREE CONDITION CODE										D.B.H. (INCHES)									
			20	40	60	I	II	III	1920	25	30	35	40	45	50	55	60	70	1920	25	30	35	40	45	50	55	60	70
61	27	1	2	2	2	32	32	42	0	0	0	0	0	0	0	0	0	41	21.7	22.2	22.6	23.0	23.0	23.6	23.7	24.0	24.2	24.8
61	27	2	2	2	2	33	34	44	0	0	0	0	0	0	0	0	0	41	21.0	21.2	21.2	21.4	21.6	21.9	21.9	22.0	22.1	22.3
61	27	3	2	2	2	32	34	43	0	0	0	0	0	13	0	0	0	41	17.5	18.1	18.5	18.9	19.3	19.4	19.6	19.7	19.8	20.1
61	27	4	2	2	2	32	33	43	0	0	0	0	0	14	0	0	0	41	15.3	15.9	16.2	16.6	16.8	17.0	17.2	17.4	17.6	18.1
61	27	5	2	2	2	32	33	43	9	0	0	0	0	0	0	0	0	41	22.7	23.2	23.6	24.0	24.3	24.6	24.7	24.9	25.0	25.6
61	27	6	2	2	2	33	33	44	0	0	61	0	0	0	0	0	0	41	32.3	32.7	32.9	33.1	33.3	33.5	33.6	33.8	33.9	34.2
61	27	7	1	1	1	1X	1X	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.5	5.0	5.7	6.2
61	27	8	1	1	1	1X	10	20	0	0	0	0	0	0	0	0	0	0	.0	.0	4.0	5.0	6.5	7.8	8.8	10.0	10.9	12.6
61	27	9	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.7	6.2
61	27	10	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.0	5.2	6.0	6.5	7.0	7.5	8.8
61	27	11	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	3	.0	.0	.0	.0	4.[illegible]	4.7	5.3	6.0	6.6	8.0
61	27	12	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	[illegible].1	4.5	5.0	5.4	6.6
61	27	13	1	1	2	20	21	31	0	0	0	0	0	0	0	0	0	41	17.1	18.2	19.0	19.8	20.7	21.4	22.1	22.6	23.1	24.2
61	27	14	1	1	2	22	22	33	0	3	0	0	0	14	0	0	0	2	14.4	14.7	15.0	15.5	15.9	16.3	16.7	16.8	17.1	17.3
61	27	15	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.5	5.0	6.6
61	27	16	2	2	2	33	34	44	0	3	32	0	0	0	0	0	0	93	28.5	28.9	29.1	29.3	29.4	29.5	29.5	29.6	29.7	29.7
61	27	17	1	1	2	20	22	32	0	3	0	0	0	0	0	0	0	41	21.0	22.0	22.8	23.6	24.2	24.8	25.3	25.6	26.2	26.7
61	27	18	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.5	6.0
61	27	19	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.6	6.0
61	27	20	1	1	2	22	22	33	0	0	0	0	0	0	0	0	0	41	24.8	25.4	25.8	26.2	26.6	27.1	27.4	27.8	28.0	28.4
61	27	21	1	1	2	22	22	33	0	0	0	0	0	0	0	0	0	41	12.5	13.2	13.9	14.1	14.5	14.[illegible]	15.4	15.6	15.9	16.1
61	27	22	1	1	2	20	21	31	0	74	0	0	0	0	0	0	0	41	21.5	22.7	23.9	24.6	25.5	26.5	26.9	27.4	27.9	29.0
61	27	23	1	1	1	1X	11	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	4.6	5.2	5.6	6.0	7.8
61	27	24	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.6	4.3	4.7	5.3	6.8
61	27	25	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	2	.0	.0	.0	.0	4.1	4.4	4.6	5.0	5.3	6.2
61	27	26	1	1	2	21	21	32	0	3	0	0	0	0	0	0	0	41	15.3	16.4	17.2	17.9	18.4	19.0	19.5	19.9	20.2	20.8
61	27	27	1	1	1	21	22	32	0	0	0	0	0	0	0	0	0	41	18.0	18.8	19.6	20.3	20.9	21.5	21.5	21.9	22.5	22.7
61	27	28	1	1	1	10	11	11	0	0	0	0	0	0	0	0	0	0	.0	4.0	4.8	5.9	6.7	7.4	7.9	8.7	9.4	10.4
61	27	29	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.0	4.6	5.1	5.8	7.2
61	27	30	1	1	2	21	22	32	0	0	0	0	0	0	0	0	0	40	16.6	17.4	18.4	18.8	19.4	20.0	20.2	20.7	21.2	21.7
61	27	31	1	1	2	21	22	32	0	3	0	0	0	14	0	0	0	41	23.1	23.8	24.5	25.0	25.5	26.2	26.5	26.8	27.3	27.9
61	27	32	1	1	1	11	11	12	0	0	0	0	0	0	0	0	0	0	4.[illegible]	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.4	9.2
61	27	33	1	1	2	20	22	31	0	0	0	0	0	0	0	0	0	41	20.[illegible]	22.0	22.9	23.8	24.7	25.3	25.7	25.9	26.5	27.5
61	27	34	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.2	4.7	6.2
61	27	35	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.3	4.8	6.3
61	27	36	2	2	2	32	32	32	0	3	31	31	0	30	30	30	32	32	24.2	24.8	25.2	25.7	26.2	26.7	26.9	27.3	27.6	28.1
61	27	37	2	2	2	43	44	44	0	3	52	30	30	31	31	31	32	32	31.6	31.8	32.0	32.3	32.4	32.4	32.5	32.5	32.5	32.5
61	27	38	2	2	2	31	32	32	0	0	0	40	0	40	30	31	41	41	24.8	25.6	26.3	26.8	27.5	28.0	28.4	28.9	29.0	29.8
61	27	39	2	2	2	32	34	34	0	0	0	40	0	3	40	30	41	41	24.9	25.2	25.5	25.6	26.0	26.2	26.2	26.2	26.2	26.4
61	27	40	2	2	2	34	33	33	0	74	0	0	0	0	0	64	0	10	8.3	8.5	[illegible].5	8.6	8.9	9.0	9.1	9.3	9.6	10.0
61	27	41	1	1	1	12	12	13	0	0	0	0	0	0	0	0	0	2	7.9	8.4	[illegible].8	9.1	9.5	9.9	10.1	10.5	10.7	11.1
61	27	42	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.[illegible]	4.6	5.2	5.9	7.4
61	27	43	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.3	4.7	5.0	5.6	6.4
61	27	44	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.1	4.4	4.8	5.1	5.5	6.0
61	27	45	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.0	4.6	5.3	5.7	6.1	7.3
61	27	46	1	1	1	1X	11	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	4.0	5.2	6.1	6.6	7.1	7.6	8.7
61	27	47	1	1	1	1X	11	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	3.9	4.3	4.9	5.4	6.0	6.8
61	27	48	1	1	1	1X	12	12	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	4.2	4.7	5.2	5.5	5.8	6.5
61	27	49	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.2	4.6	5.4	7.0
61	27	50	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.7	4.2	4.7	6.4
61	27	51	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.1	4.7	6.2
61	27	52	1	1	1	1X	10	12	0	0	0	0	0	0	0	0	0	2	.0	.0	4.0	4.5	5.5	7.9	7.9	7.9	8.0	8.8
61	27	53	1	1	1	1X	11	10	0	0	0	0	0	0	0	0	[illegible]	0	.0	.0	.0	.0	3.6	4.2	4.7	5.2	5.9	7.6
61	27	54	2	2	2	31	32	34	0	3	[illegible]	0	0	0	0	40	40	41	27.3	27.5	28.5	29.0	29.5	29.8	30.0	30.4	30.4	30.7
61	27	55	2	2	2	32	33	33	0	0	0	0	0	0	30	40	40	41	26.0	26.5	26.7	26.9	27.4	27.6	27.8	27.8	28.3	28.5
61	27	56	2	2	2	42	42	33	0	0	30	0	0	0	0	40	40	41	35.5	35.9	36.1	36.5	36.9	37.1	37.5	37.9	38.0	38.5
61	27	57	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.6	5.1	6.8
61	27	58	2	2	2	31	32	33	0	0	0	30	0	0	30	40	40	41	25.5	26.2	26.9	27.4	27.9	28.4	28.7	28.9	29.2	29.5
61	27	59	2	2	2	32	32	32	0	0	0	30	0	[illegible]	30	30	40	40	14.7	15.5	15.7	16.1	16.7	16.9	17.3	17.9	18.3	19.2
61	27	60	2	2	2	32	34	34	0	3	0	0	0	0	30	0	0	3	16.8	17.2	17.3	17.6	18.0	18.2	18.3	18.3	18.4	18.6
61	27	61	2	2	2	33	34	34	0	0	0	0	0	0	30	30	0	9	19.2	19.5	19.6	19.8	20.0	20.1	20.2	20.3	20.3	20.5
61	27	62	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.[illegible]	.0	.[illegible]	.0	.0	3.6	4.3	6.1
61	27	63	2	2	2	44	44	44	40	45	40	40	41	41	41	41	41	41	32.1	32.5	32.5	32.7	32.8	32.8	32.8	32.8	32.9	32.9
61	27	64	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	4.0	4.4	6.3
61	27	65	1	1	2	20	20	31	0	0	0	0	0	0	0	0	0	41	14.6	16.2	17.4	18.6	19.8	20.7	21.5	22.1	23.4	24.0
61	27	66	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	3.6	4.2	4.8	6.3
61	27	67	1	1	1	1X	10	10	0	0	0	0	0	0	0	[illegible]	0	0	.0	.0	4.0	4.[illegible]	5.5	[illegible].3	7.1	7.9	8.7	10.2
61	27	68	1	1	1	1X	10	11	0	0	0	0	0	14	0	0	0	3	.0	.0	3.[illegible]	4.[illegible]	6.0	[illegible].9	7.8	8.4	9.1	10.1
61	27	69	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	4.1	4.7	5.3	5.9	7.5
61	27	70	1	1	1	1X	10	10	0	0	0	0	0	[illegible]	0	0	0	0	.0	.0	3.6	4.3	5.7	6.8	7.6	8.6	9.7	11.3
61	27	71	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	4.0	4.7	5.3	7.0
61	27	72	1	1	1	20	20	21	0	0	0	0	0	0	0	0	0	40	12.9	14.4	15.[illegible]	16.6	17.4	18.3	18.9	19.6	20.3	21.1
61	27	73	1	1	1	21	23	24	0	0	0	0	0	0	0	0	0	40	16.7	17.7	18.4	19.0	19.4	19.7	20.0	20.0	20.1	20.2
61	27	74	1	1	1	20	21	20	0	0	0	0	0	0	0	0	0	40	13.4	15.0	16.3	17.5	18.4	19.3	19.9	20.3	21.3	23.4
61	27	75	1	1	2	20	21	32	0	3	0	0	0	0	0	0	0	40	19.1	20.8	21.8	22.5	23.1	24.0	24.5	24.7	25.6	26.1
61	27	76	1	1	1	20	22	22	0	52	0	0	0	0	0	0	0	40	17.2	17.9	18.7	19.5	20.0	20.2	20.6	21.1	21.4	22.0
61	27	77	1	1	1	21	22	21	0	0	0	0	0	0	0	0	0	41	14.2	15.3	16.1	16.7	17.2	17.7	18.1	18.3	18.9	19.8
61	27	78	1	1	2	21	21	32	0	0	0	0	0	0	0	0	0	41	20.5	21.7	22.3	23.2	23.7	24.3	24.7	25.4	25.7	26.4
61	27	79	1	1	1	1X	1X	10	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	.0	.0	3.8	4.4	6.2
61	27	80	1	1	1	1X	1X	11	0	0	0	0	0	0	0	0	0	0	.0	.0	.0	.0	.0	3.7	4.3	4.8	5.3	6.9

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61   27    81    1  1  1    20 20 21     0  0  0  0  0  0  0  0 40 41     16.5 17.6 18.7 19.8 20.6 21.4 22.0 22.8 23.5 24.3
61   27    82    1  1  1    21 22 22     0  0  0  0  0  0  0  0 40 41     12.7 13.5 14.2 14.6 15.1 15.5 15.7 16.1 16.5 17.0
61   27    83    1  1  1    20 21 22     0  0  0  0  0  0  0  0 40 41     15.6 15.7 16.5 17.1 18.0 18.5 19.1 19.8 20.4 21.2
61   27    84    1  1  1    1X 11 11     0  0  0  0  0  0  0  0  0  0       .0   .0   .0  4.2  4.7  5.3  5.7  6.3  7.0  8.4
61   27    85    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0   .0   .0   .0   .0   .0  4.1  4.6  5.0  6.7
61   27    86    1  1  1    1X 11 11     0  0  0  0  0  0  0  0  0  0       .0   .0   .0   .0  4.0  4.6  5.1  5.6  6.2  7.7
61   27    87    1  1  1    1X 1X 10     0  0  0  0  0  0  0  0  0  0       .0   .0   .0   .0   .0   .0   .0  3.8  4.5  6.0
61   27    88    1  1  1    21 22 22     0  0  0  0  0  0  0  0  0  0     10.3 11.0 11.6 12.2 12.8 13.4 13.7 14.2 14.7 15.4
61   27    89    1  1  2    21 21 32     0  0  0  0  0  0  0  0  0 40     25.1 26.1 26.9 27.5 28.2 28.8 29.3 29.7 30.4 31.0
61   27    90    1  1  2    21 21 31    75 46  0  9  0  0 30  0  0 40     19.4 20.1 20.7 21.6 21.9 22.6 22.8 23.4 23.9 25.1

61   27    91    1  1  2    22 23 34     0  0  0  0  0  0  0  0  0 41     24.9 25.4 25.9 26.0 26.7 26.9 27.1 27.3 27.6 27.7
61   27    92    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0   .0   .0   .0   .0   .0  3.8  4.3  5.0  6.4
61   27    93    1  1  1    1X 11 10     0  0  0  0  0  0  0  0  0  0       .0   .0   .0   .0  4.2  4.7  5.3  6.0  6.7  8.1
61   27    94    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  0       .0   .0   .0   .0   .0   .0  4.1  4.7  5.3  6.7
61   27    95    1  1  1    1X 1X 11     0  0  0  0  0  0  0  0  0  2       .0   .0   .0   .0   .0  4.0  4.6  5.2  5.8  7.1
61   27    96    1  1  1    1X 11 11     0  0  0  0  0  0  0  0  0  0       .0   .0   .0  4.2  4.6  5.2  5.9  6.4  7.0  8.3
61   27    97    1  1  1    1X 1X 12     0  0  0  0  0  0  0  0  0  0       .0   .0   .0   .0   .0  4.0  4.3  4.7  5.1  6.0
61   27    98    2  2  2    20 22 24     0  0  0  0  0  3  0  0  0 95     14.7 15.0 16.2 17.0 17.7 18.5 18.6 18.9 19.0 19.0
61   27    99    1  0  0    2X 44 44     0  9 19  0  0  0  0  0  0  0     11.4 11.5 11.5   .0   .0   .0   .0   .0   .0   .0
61   27   100    2  2  0    33 3X 44     0  0 12  0 64  0 90  0  0  0     25.3 25.7 26.1 26.2 26.4 26.5 26.5   .0   .0   .0

61   27   101    2  0  0    4X 44 44     0  0  0 92  0  0  0  0  0  0     33.1 33.3 33.3 33.3   .0   .0   .0   .0   .0   .0
61   27   102    2  2  2    44 44 44    24 24 24 24 24 24 24 24 24 94     30.6 30.7 30.8 30.8 30.8 30.8 30.8 30.8 30.8 30.8
61   27   103    2  2  2    4X 4X 4X    24 24 92  0  0  0  0  0  0  0     30.1 30.1 30.1   .0   .0   .0   .0   .0   .0   .0
61   27   104    1  1  1    12 1X 1X    46 46 46 46 96  0  0  0  0  0     10.1 11.0 11.4 11.8 12.0   .0   .0   .0   .0   .0
61   27   105    2  2  2    44 4X 4X    76  0  0  0  0 90  0  0  0  0     38.8 39.1 39.2 39.4 39.5 39.5   .0   .0   .0   .0
61   27   106    2  2  2    4X 4X 4X    91  0  0  0  0  0  0  0  0  0     32.6   .0   .0   .0   .0   .0   .0   .0   .0   .0
61   27   107    2  2  2    43 44 4X    23 23 23 24 24 24 24 24 94  0     22.8 23.0 23.2 23.4 23.6 23.7 23.7 23.8 23.9   .0
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Section 2: SUBPLOT DATA

TABLE .1:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 1 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.80	2.40	3.20	7.20	8.00	17.60	30.80	20.80	.00	.00
5	.00	.40	1.60	1.20	6.80	8.00	12.40	32.80	32.40	.00
6	.00	.40	1.20	2.00	.80	6.40	10.40	11.20	25.60	25.20
7	.40	.00	.40	1.60	1.60	1.20	6.00	9.20	9.60	28.40
8	.00	.40	.00	.40	2.00	1.60	1.20	5.60	8.80	13.60
9	.00	.00	.40	.40	.40	2.00	2.40	2.00	4.80	8.00
10	.40	.00	.00	.00	.40	.40	1.20	1.60	1.60	5.60
11	.00	.40	.00	.40	.00	.40	.80	1.20	2.00	1.60
12	.00	.00	.40	.00	.40	.00	.00	.40	.80	1.60
13	.00	.00	.00	.00	.00	.40	.40	.00	.00	1.60
14	.00	.00	.00	.40	.40	.00	.00	.40	.40	.00
15	.80	.80	.40	.40	.00	.40	.00	.00	.00	.40
16	.00	.00	.40	.40	.40	.40	.80	.40	.40	.40
17	.40	.40	.40	.00	.40	.40	.40	.40	.40	.00
18	.40	.40	.00	.40	.40	.40	.40	.80	.80	.80
19	1.60	.00	.40	.40	.00	.00	.00	.00	.00	.40
20	.40	2.00	.80	.00	.40	.40	.40	.00	.00	.00
21	3.20	2.80	2.80	2.00	1.20	.80	.40	.80	.80	.40
22	.80	.40	1.60	2.80	2.40	1.60	2.00	1.60	1.20	.40
23	1.20	1.20	.40	.40	1.60	2.40	2.40	2.80	2.40	2.00
24	2.40	2.40	1.60	.00	.00	.40	.40	.00	.80	2.00
25	.40	1.20	2.80	3.60	2.00	1.20	1.20	1.60	1.60	.80
26	.80	.80	.80	1.60	3.20	2.80	2.00	.80	.80	1.20
27	.80	.40	.40	.40	.40	1.60	2.40	3.20	2.40	2.00
28	.40	.40	.00	.00	.00	.00	.00	.00	.80	1.60
29	.40	.80	.80	.00	.00	.00	.00	.00	.00	.00
30	.00	.00	.40	1.20	.40	.40	.40	.40	.00	.00
31	.00	.00	.00	.00	.80	.80	.40	.40	.80	.40
32	.00	.00	.00	.00	.00	.00	.40	.40	.40	.40
33	.00	.00	.00	.00	.00	.00	.00	.00	.00	.40
34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.40	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.40	.40	.40	.40	.40	.40	.40	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	16.00	18.40	21.60	27.60	34.80	52.40	80.00	99.20	99.60	99.20

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.07	.20	.28	.63	.73	1.58	2.88	2.02	.00	.00
5	.00	.06	.23	.16	.93	1.12	1.64	4.47	4.65	.00
6	.00	.07	.23	.40	.17	1.23	2.10	2.17	5.11	5.38
7	.10	.00	.12	.43	.45	.32	1.57	2.57	2.57	7.55
8	.00	.13	.00	.13	.71	.59	.39	1.91	3.16	4.74
9	.00	.00	.20	.16	.17	.89	1.05	.91	2.07	3.70
10	.23	.00	.00	.00	.21	.21	.65	.90	.86	3.10
11	.00	.28	.00	.25	.00	.25	.51	.79	1.34	1.04
12	.00	.00	.34	.00	.30	.00	.00	.30	.64	1.25
13	.00	.00	.00	.00	.00	.35	.39	.00	.00	1.46
14	.00	.00	.00	.40	.46	.00	.00	.43	.46	.00
15	.97	1.00	.51	.52	.00	.52	.00	.00	.00	.52
16	.00	.00	.54	.57	.54	.55	1.10	.56	.57	.57
17	.62	.64	.66	.00	.61	.65	.66	.60	.63	.00
18	.68	.71	.00	.68	.70	.71	.71	1.41	1.45	1.47
19	3.23	.00	.76	.80	.00	.00	.00	.00	.00	.80
20	.85	4.34	1.75	.00	.84	.87	.90	.00	.00	.00
21	7.63	6.83	6.82	4.88	2.97	2.02	1.01	1.93	1.97	1.01
22	2.15	1.03	4.14	7.46	6.43	4.27	5.35	4.32	3.28	1.05
23	3.45	3.50	1.16	1.19	4.64	6.92	7.01	8.23	7.02	5.80
24	7.56	7.64	5.10	.00	.00	1.24	1.28	.00	2.44	6.22
25	1.32	3.99	9.48	12.21	6.79	4.04	4.06	5.41	5.48	2.73
26	2.92	2.95	2.98	5.93	11.89	10.44	7.47	2.96	2.98	4.38
27	3.12	1.58	1.60	1.60	1.63	6.36	9.53	12.71	9.53	7.96
28	1.76	1.69	.00	.00	.00	.00	.00	.00	3.38	6.89
29	1.81	3.67	3.67	.00	.00	.00	.00	.00	.00	.00
30	.00	.00	1.91	5.90	1.98	2.03	2.03	2.03	.00	.00
31	.00	.00	.00	.00	4.14	4.22	2.11	2.14	4.21	2.07
32	.00	.00	.00	.00	.00	.00	2.18	2.22	2.29	2.18
33	.00	.00	.00	.00	.00	.00	.00	.00	.00	2.42

34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	3.23	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	3.27	3.32	3.35	3.37	3.37	3.37	3.37	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	41.70	43.57	45.82	47.66	50.65	54.74	59.95	64.36	66.09	74.27

TABLE 2.2:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 2 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.40	1.60	3.60	6.40	6.80	10.80	27.60	37.60	8.00	.00
5	.00	.40	2.40	2.00	5.60	6.80	11.20	25.60	40.00	.00
6	.00	.00	.40	1.60	1.60	4.80	7.20	9.60	21.20	30.00
7	.00	.00	.00	.80	1.60	2.00	3.20	8.00	10.40	31.20
8	.00	.00	.00	.40	.80	1.20	2.00	3.20	6.40	12.80
9	.00	.00	.00	.00	.00	.80	2.00	1.20	3.20	10.40
10	.00	.00	.00	.00	.00	.00	.00	1.60	.80	4.00
11	.80	.00	.00	.00	.00	.00	.00	.00	1.20	1.20
12	.00	.40	.00	.00	.00	.00	.00	.00	.00	.80
13	.00	.40	.80	.40	.00	.00	.00	.00	.00	.80
14	.40	.40	.40	.80	.40	.40	.00	.00	.00	.00
15	.40	.00	.00	.00	.80	.40	.80	.40	.40	.00
16	.80	.40	.40	.00	.00	.40	.40	.40	.40	.40
17	.40	1.20	.00	.40	.40	.00	.00	.40	.00	.40
18	.80	.40	1.20	.40	.40	.80	.40	.40	.40	.00
19	.40	.80	.40	.80	.80	.40	.80	.80	1.20	1.20
20	.80	.00	.80	.80	.00	.40	.40	.00	.00	.40
21	.40	1.20	.40	.80	1.60	1.20	.40	.40	.40	.00
22	1.20	.40	1.20	.80	.40	.80	1.20	.80	.40	.80
23	1.60	1.60	1.20	1.60	1.60	.80	1.20	1.20	1.20	.80
24	.80	1.20	.80	.80	1.20	1.20	1.20	1.20	1.20	1.60
25	.80	.40	1.20	.40	.00	.40	.40	.80	1.20	.00
26	.40	.80	.00	.80	1.20	.80	.80	.80	.80	1.60
27	.00	.00	.80	.40	.00	.40	.40	.40	.40	.40
28	1.20	.80	.40	.80	.80	.40	.40	.40	.00	.40
29	.00	.80	.80	.80	.80	1.60	1.60	1.60	1.20	1.20
30	.40	.40	.80	.40	.40	.00	.00	.00	.40	.40
31	.00	.00	.00	.40	.40	.40	.40	.40	.40	.40
32	.40	.00	.00	.00	.00	.40	.40	.40	.00	.00
33	.40	.40	.00	.00	.00	.00	.00	.00	.40	.40
34	.40	.80	1.20	1.20	.80	.40	.40	.40	.00	.00
35	.00	.00	.00	.00	.40	.80	.80	.80	.80	.40
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.40
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	13.20	14.80	19.20	[illegible]4.00	28.80	38.80	65.60	98.80	102.40	102.40

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.03	.13	.30	.61	.64	1.01	2.55	3.57	.86	.00
5	.00	.05	.30	.27	.80	.96	1.55	3.48	5.51	.00
6	.00	.00	.07	.32	.34	.92	1.47	1.87	4.14	6.34
7	.00	.00	.00	.19	.42	.57	.81	2.11	2.82	8.45
8	.00	.00	.00	.14	.26	.41	.68	1.14	2.19	4.48
9	.00	.00	.00	.00	.00	.33	.90	.52	1.42	4.61
10	.00	.00	.00	.00	.00	.00	.00	.87	.44	2.20
11	.55	.00	.00	.00	.00	.00	.00	.00	.78	.78
12	.00	.32	.00	.00	.00	.00	.00	.00	.00	.61
13	.00	.35	.74	.39	.00	.00	.00	.00	.00	.76

14	.42	.43	.44	.90	.42	.45	.00	.00	.00	.00
15	.50	.00	.00	.00	.97	.50	.98	.50	.52	.00
16	1.16	.54	.59	.00	.00	.55	.59	.54	.57	.57
17	.61	1.95	.00	.62	.65	.00	.00	.63	.00	.60
18	1.46	.74	2.13	.69	.72	1.43	.71	.75	.68	.00
19	.75	1.63	.77	1.53	1.58	.76	1.52	1.55	2.33	2.35
20	1.69	.00	1.76	1.82	.00	.88	.92	.00	.00	.84
21	.95	2.84	.97	1.94	3.88	3.01	.99	.95	.98	.00
22	3.23	1.06	3.12	2.14	1.08	2.18	3.15	2.10	1.03	2.05
23	4.61	4.62	3.47	4.63	4.63	2.32	3.49	3.44	3.39	2.29
24	2.43	3.79	2.47	2.54	3.82	3.79	3.85	3.84	3.81	5.15
25	2.69	1.39	4.11	1.42	.00	1.36	1.36	2.73	4.15	.00
26	1.43	2.95	.00	2.89	4.40	2.94	2.97	2.98	3.01	5.88
27	.00	.00	3.15	1.64	.00	1.56	1.57	1.61	1.63	1.58
28	5.19	3.47	1.73	3.46	3.53	1.72	1.76	1.77	.00	1.66
29	.00	3.59	3.58	3.63	3.67	7.31	7.37	7.40	5.54	5.62
30	1.96	1.99	3.95	2.02	2.03	.00	.00	.00	1.91	1.98
31	.00	.00	.00	2.07	2.15	2.04	2.04	2.04	2.04	2.04
32	2.29	.00	.00	.00	.00	2.22	2.25	2.30	.00	.00
33	2.43	2.38	.00	.00	.00	.00	.00	.00	2.33	2.36
34	2.55	5.06	7.58	7.73	5.04	2.46	2.48	2.48	.00	.00
35	.00	.00	.00	.00	2.61	5.30	5.33	5.42	5.45	2.72
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	2.80
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	36.95	39.27	41.25	43.59	43.67	46.98	51.30	56.64	57.53	68.71

TABLE 2.3:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 3 AREA: 2.35 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	2.55	3.83	2.98	.85	3.40	5.96	10.21	22.13	2.98	.00
5	.85	1.28	2.13	2.98	.85	2.13	6.81	9.79	22.55	.00
6	.85	1.70	3.40	1.70	2.55	2.13	1.28	5.96	10.64	13.19
7	.85	1.28	1.28	2.55	2.55	2.98	1.70	1.28	3.83	13.62
8	.85	.00	.85	1.70	2.13	1.70	4.26	2.98	3.40	10.64
9	.43	1.70	.43	1.28	2.13	2.55	1.28	2.98	2.13	6.38
10	.85	.43	.43	.43	.85	1.70	3.40	2.55	2.55	1.28
11	1.70	1.28	2.13	.43	.43	.85	.43	2.13	2.98	3.83
12	.85	1.70	2.13	3.40	2.98	2.55	1.70	.43	1.28	2.13
13	1.70	1.28	.85	1.28	1.70	.85	2.13	1.70	1.70	2.13
14	2.13	.85	1.28	.85	.85	1.70	1.70	2.55	1.28	.43
15	2.98	2.98	1.28	1.70	1.28	2.13	2.13	1.28	1.70	1.70
16	2.13	1.70	3.40	1.28	1.70	1.28	.43	1.28	1.70	2.98
17	2.55	2.55	1.70	2.55	1.28	1.28	1.70	.85	1.28	.43
18	2.55	2.55	2.55	2.98	2.98	1.70	.85	1.28	1.28	1.28
19	1.28	2.55	2.55	1.70	2.55	3.40	3.83	3.83	2.13	2.13
20	2.55	1.28	1.28	2.55	2.55	2.55	1.70	1.70	2.55	1.70
21	.43	2.55	1.70	1.28	1.70	1.70	2.13	2.13	2.55	2.55
22	2.13	.00	1.70	2.13	1.70	1.28	1.70	2.13	1.70	2.55
23	.43	2.13	2.55	2.13	2.55	2.55	2.13	1.28	.85	.85
24	.00	.43	.00	1.28	1.70	1.70	2.13	2.55	2.55	2.13
25	.85	.43	.43	.43	.43	.85	1.70	1.70	2.98	2.98
26	.00	.43	.85	.43	.43	.00	.00	.43	.43	1.28
27	.43	.43	.00	.43	.43	.85	.43	.43	.43	.85
28	.00	.00	.43	.00	.00	.00	.43	.43	.43	.43
29	.43	.00	.00	.43	.43	.43	.43	.43	.43	.43
30	.43	.85	.43	.00	.00	.00	.00	.00	.00	.00
31	.43	.43	.85	1.28	.85	.85	.85	.85	.43	.43
32	.00	.00	.00	.00	.43	.00	.00	.00	.00	.00
33	.00	.00	.00	.00	.00	.43	.43	.43	.43	.00
34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.43
35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	33.19	36.60	39.57	[illegible]	43.40	48.08	57.87	77.45	79.15	78.72

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.26	.35	.24	.07	.34	.51	.87	2.10	.30	.00
5	.11	.17	.31	.41	.10	.28	.89	1.29	3.06	.00
6	.16	.33	.69	.30	.49	.42	.27	1.09	2.07	2.84
7	.23	.34	.36	.68	.68	.80	.43	.36	.96	3.61
8	.29	.00	.31	.61	.75	.57	1.45	1.04	1.21	3.65
9	.18	.77	.18	.56	.95	1.12	.58	1.32	.94	2.71
10	.47	.26	.23	.25	.45	.87	1.86	1.45	1.39	.70
11	1.18	.87	1.42	.28	.30	.54	.28	1.41	1.97	2.62
12	.65	1.32	1.66	2.68	2.40	2.09	1.36	.32	.97	1.75
13	1.53	1.23	.79	1.18	1.61	.76	1.96	1.60	1.56	1.99
14	2.36	.92	1.39	.91	.93	1.79	1.87	2.76	1.42	.49
15	3.68	3.68	1.57	2.13	1.60	2.70	2.77	1.63	2.06	2.15
16	3.02	2.36	4.84	1.80	2.38	1.84	.60	1.77	2.33	4.15
17	4.10	4.01	2.81	4.03	2.01	2.06	2.68	1.38	2.06	.70
18	4.58	4.46	4.55	5.37	5.28	3.07	1.50	2.21	2.29	2.26
19	2.48	4.94	5.02	3.33	4.94	6.70	7.53	7.69	4.30	4.23
20	5.70	2.82	2.70	5.53	5.58	5.63	3.68	3.73	5.48	3.66
21	.98	6.15	4.12	3.09	4.15	4.16	5.06	5.11	6.19	6.10
22	5.80	.00	4.38	5.64	4.57	3.41	4.46	5.73	4.54	6.78
23	1.25	6.03	7.41	6.18	7.45	7.38	6.17	3.76	2.44	2.43
24	.00	1.33	.00	3.98	5.46	5.43	6.64	8.02	7.99	6.83
25	2.88	1.49	1.42	1.47	1.47	2.87	5.78	5.78	10.13	10.20
26	.00	1.52	3.11	1.61	1.63	.00	.00	1.54	1.61	4.71
27	1.68	1.74	.00	1.65	1.70	3.43	1.70	1.70	1.73	3.45
28	.00	.00	1.81	.00	.00	.00	1.78	1.81	1.82	1.87
29	1.97	.00	.00	1.90	1.90	1.94	1.95	1.97	1.97	1.99
30	2.06	4.19	2.16	.00	.00	.00	.00	.00	.00	.00
31	2.27	2.29	4.49	6.78	4.50	4.55	4.55	4.56	2.27	2.29
32	.00	.00	.00	.00	2.38	.00	.00	.00	.00	.00
33	.00	.00	.00	.00	.00	2.48	2.50	2.54	2.54	.00
34	.00	.00	.00	.00	.00	.00	.00	.00	.00	2.65
35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	49.88	53.58	57.97	[illegible]	66.01	67.41	71.18	75.58	77.60	86.82

TABLE 2.4:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 4 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	10.00	12.00	9.20	6.80	.40	.40	9.60	13.60	1.20	.00
5	8.40	10.80	12.00	9.60	10.40	4.40	1.60	8.40	16.80	.00
6	5.20	8.40	10.80	14.00	10.40	10.40	9.20	5.20	8.80	9.20
7	3.60	4.80	6.00	7.60	12.40	12.40	11.60	8.80	6.80	15.20
8	4.40	4.80	6.00	5.20	6.00	10.00	10.00	11.20	10.00	13.60
9	1.60	3.20	4.80	6.00	5.20	6.00	8.00	9.20	9.20	8.80
10	.80	2.00	3.60	4.00	6.40	5.20	5.20	6.80	8.40	8.40
11	1.60	1.20	1.60	3.60	4.00	4.00	6.40	4.40	7.20	7.60
12	.80	.80	1.60	2.80	2.40	3.60	3.20	5.20	4.40	6.80
13	2.00	1.60	1.60	.80	2.40	2.40	2.80	3.20	3.20	3.60
14	1.60	2.40	1.60	1.60	2.00	2.80	2.80	3.60	3.60	5.20
15	2.80	1.20	2.00	2.40	.80	1.20	1.60	2.00	3.60	2.80
16	.40	2.00	.40	.80	2.40	2.00	2.00	2.40	.40	2.40
17	.40	.80	2.00	1.00	1.20	1.20	1.20	.80	2.40	2.00
18	.40	.40	.80	1.60	2.00	1.60	1.60	1.60	1.20	.80
19	1.60	.40	.40	.80	.00	1.20	1.20	2.00	2.40	2.40
20	1.20	2.00	2.00	1.20	1.20	.40	.40	.00	.40	1.60
21	.00	.40	.80	1.20	1.20	1.60	1.60	2.00	1.20	.80
22	.40	.40	.00	.40	1.20	.80	.80	.80	1.60	.80
23	1.20	.40	.80	.80	.00	.80	1.20	.80	.40	1.20

24	.40	.80	.00	.00	.80	.40	.40	.80	1.20	1.20
25	1.60	1.20	1.60	1.20	.40	.40	.40	.00	.00	.40
26	.80	1.60	1.60	1.60	1.60	2.00	.40	.80	.80	.40
27	.80	.80	.40	.80	1.60	1.20	2.80	2.40	1.20	1.20
28	1.20	.80	1.60	1.60	1.60	2.00	2.00	2.00	2.80	2.40
29	.40	.80	.40	.40	.40	.40	.00	.40	.40	1.20
30	.80	.40	.40	.40	.40	.00	.40	.40	.40	.00
31	.40	.80	1.20	.80	.40	.40	.40	.40	.40	.00
32	.40	.40	.40	.40	.80	1.20	1.20	.40	.40	.40
33	.00	.00	.00	.40	.40	.40	.40	1.20	1.20	.80
34	.40	.40	.00	.00	.00	.00	.00	.00	.00	.40
35	.00	.00	.40	.40	.40	.40	.40	.00	.00	.00
36	.00	.00	.00	.00	.00	.00	.00	.40	.40	.40
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	55.60	68.00	76.00	80.80	80.80	81.20	90.80	101.20	102.40	102.00

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.94	1.05	.87	.65	.04	.04	.85	1.30	.12	.00
5	1.13	1.46	1.67	1.35	1.48	.67	.24	1.11	2.35	.00
6	1.06	1.65	2.07	2.83	2.12	2.12	1.84	1.05	1.75	1.97
7	1.01	1.28	1.57	2.02	3.35	3.39	3.22	2.42	1.92	4.06
8	1.53	1.73	2.10	1.82	2.06	3.55	3.56	3.96	3.55	4.81
9	.72	1.41	2.14	2.66	2.28	2.69	3.57	4.12	4.16	3.91
10	.44	1.08	2.02	2.14	3.47	2.96	2.88	3.69	4.58	4.75
11	1.02	.81	1.06	2.34	2.68	2.62	4.29	2.89	4.87	5.10
12	.65	.60	1.26	2.26	1.90	2.83	2.60	4.00	3.55	5.35
13	1.87	1.49	1.56	.77	2.20	2.21	2.60	2.97	2.96	3.38
14	1.74	2.58	1.77	1.69	2.19	2.96	3.02	3.86	3.88	5.62
15	3.50	1.51	2.49	2.94	.99	1.47	1.95	2.42	4.45	3.44
16	.57	2.82	.57	1.06	3.25	2.81	2.84	3.42	.57	3.41
17	.61	1.29	3.09	2.51	1.97	1.88	1.91	1.25	3.66	3.09
18	.68	.72	1.41	2.74	3.62	2.84	2.87	2.87	2.15	1.41
19	3.16	.81	.77	1.64	.00	2.35	2.35	3.92	4.76	4.79
20	2.57	4.30	4.43	2.70	2.65	.92	.87	.00	.86	3.49
21	.00	.94	1.93	2.88	2.87	3.82	3.82	4.85	2.95	2.00
22	1.02	1.08	.00	1.07	3.22	2.14	2.06	2.10	4.21	2.16
23	3.35	1.14	2.31	2.38	.00	2.26	3.47	2.37	1.19	3.35
24	1.26	2.43	.00	.00	2.48	1.23	1.23	2.47	3.76	3.82
25	5.50	4.10	5.44	4.19	1.42	1.32	1.39	.00	.00	1.41
26	2.92	5.91	5.95	6.02	5.99	7.53	1.43	2.89	2.97	1.44
27	3.22	3.28	1.56	3.13	6.34	4.77	1.06	9.58	4.80	4.83
28	5.13	3.37	6.73	6.81	6.85	8.57	8.64	8.60	11.97	10.29
29	1.78	3.66	1.80	1.83	1.87	1.90	.00	1.80	1.81	5.44
30	3.90	1.99	1.92	1.98	2.03	.00	1.91	1.94	1.94	.00
31	2.06	4.14	6.29	4.26	2.15	2.08	2.10	2.11	2.15	.00
32	2.19	2.23	2.28	2.19	4.40	6.73	6.83	2.28	2.28	2.21
33	.00	.00	.00	2.33	2.36	2.39	2.39	7.07	7.16	4.78
34	2.52	2.58	.00	.00	.00	.00	.00	.00	.00	2.48
35	.00	.00	2.64	2.72	2.73	2.75	2.75	.00	.00	.00
36	.00	.00	.00	.00	.00	.00	.00	2.80	2.81	2.84
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	58.04	63.46	69.70	75.91	80.98	85.80	90.55	96.07	100.13	105.64

TABLE 2.[illegible]:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 5 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	3.20	3.20	4.80	6.00	1.60	1.20	9.20	7.60	1.20	.00

5	3.60	2.00	2.40	3.60	5.20	4.00	2.80	8.00	11.60	.00
6	3.60	5.20	4.80	1.60	3.60	4.80	5.60	4.40	6.00	6.40
7	2.80	2.40	2.40	5.60	4.80	3.60	2.80	4.40	4.40	14.00
8	1.20	2.40	2.00	2.40	3.60	5.20	6.80	4.40	4.40	4.40
9	1.60	1.20	3.20	2.00	.80	1.60	1.60	3.60	4.00	4.80
10	.00	1.20	1.60	2.80	3.20	1.60	2.00	1.60	2.00	2.80
11	.80	.80	.80	1.20	1.60	2.00	1.20	1.60	2.00	2.00
12	.40	.40	.80	1.60	1.20	2.80	2.40	3.20	2.40	1.60
13	1.20	.00	.00	.00	.80	.80	1.60	1.20	1.60	2.80
14	.80	1.60	.80	.00	.00	.00	.40	1.20	1.20	.80
15	.40	.80	1.60	2.00	2.00	.80	.00	.00	.80	2.00
16	1.20	.80	.00	.40	.00	1.20	2.00	2.00	1.60	.40
17	4.00	2.40	2.40	1.60	2.00	1.20	.80	.80	1.20	2.40
18	2.00	3.20	2.80	2.80	1.20	1.60	1.20	.80	.80	.40
19	2.80	2.00	2.00	2.40	2.40	1.60	2.00	2.00	1.20	.80
20	2.80	3.60	2.80	1.20	1.60	2.40	2.40	2.00	2.80	2.40
21	2.00	1.60	2.00	2.80	2.40	1.60	2.00	2.00	1.60	1.20
22	.00	1.20	2.00	1.60	2.00	2.80	1.60	1.60	1.20	2.00
23	.80	.40	.40	1.60	1.60	.80	1.20	2.00	2.40	1.20
24	.00	.40	.80	.40	.80	2.00	2.40	1.60	1.20	2.40
25	.00	.00	.40	.40	.00	.00	.40	1.20	1.60	1.60
26	.80	.40	.40	.40	.80	.00	.00	.00	.40	.80
27	.80	.80	.80	.40	.40	1.20	.80	.40	.40	.40
28	.40	.80	.40	1.20	.80	.80	1.20	.80	.40	.80
29	.80	.80	.40	.40	.80	.80	.80	1.60	1.20	.40
30	.40	.40	1.20	1.20	.80	.80	.80	.80	.80	1.60
31	.40	.40	.00	.00	.40	.40	.40	.00	.40	.40
32	.80	.40	.40	.40	.40	.00	.00	.40	.40	.40
33	.40	.80	.80	.80	.80	.40	.40	.40	.40	.40
34	.40	.40	.40	.40	.00	.80	.80	.80	.80	.80
35	.00	.00	.40	.40	.00	.00	.00	.00	.00	.00
36	.00	.00	.00	.00	.40	.40	.40	.40	.40	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.40
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	40.40	42.00	46.00	49.60	48.00	49.20	58.00	62.80	62.80	62.80

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.30	.31	.43	.58	.17	.10	.83	.73	.12	.00
5	.51	.30	.33	.53	.74	.56	.39	1.04	1.65	.00
6	.70	1.04	1.04	.32	.71	.95	1.13	.85	1.20	1.35
7	.73	.65	.64	1.47	1.36	1.03	.76	1.16	1.12	3.74
8	.42	.81	.71	.83	1.25	1.79	2.43	1.56	1.57	1.59
9	.72	.53	1.41	.90	.37	.73	.75	1.56	1.76	2.14
10	.00	.62	.88	1.52	1.82	.90	1.16	.88	1.08	1.50
11	.52	.55	.54	.77	1.08	1.34	.87	1.04	1.33	1.33
12	.30	.31	.63	1.28	.96	2.22	1.91	2.60	1.95	1.30
13	1.14	.00	.00	.00	.69	.75	1.46	1.13	1.48	2.55
14	.87	1.70	.89	.00	.00	.00	.40	1.29	1.29	.89
15	.47	.95	1.95	2.46	2.55	1.03	.00	.00	.93	2.50
16	1.72	1.17	.00	.58	.00	1.61	2.72	2.83	2.33	.57
17	6.34	3.80	3.78	2.51	3.20	1.93	1.26	1.28	1.88	3.79
18	3.55	5.62	5.07	5.08	2.19	2.87	2.11	1.42	1.45	.72
19	5.60	4.01	3.91	4.83	4.75	3.17	3.91	3.95	2.40	1.60
20	6.00	7.88	6.14	2.64	3.49	5.19	5.28	4.36	6.13	5.28
21	4.86	3.95	4.76	6.72	5.81	3.86	4.89	4.85	3.94	2.82
22	.00	3.19	5.30	4.18	5.28	7.48	4.30	4.27	3.18	5.27
23	2.37	1.20	1.13	4.63	4.69	2.37	3.43	5.79	7.00	3.52
24	.00	1.26	2.47	1.24	2.48	6.24	7.56	5.12	3.80	7.53
25	.00	.00	1.35	1.37	.00	.00	1.32	4.03	5.40	5.53
26	2.96	1.51	1.53	1.46	3.02	.00	.00	.00	1.43	2.92
27	3.23	3.18	3.26	1.57	1.59	4.85	3.28	1.63	1.65	1.58
28	1.73	3.45	1.75	5.14	3.40	3.47	5.21	3.47	1.72	3.49
29	3.68	3.77	1.80	1.80	3.62	3.66	3.68	7.33	5.53	1.87
30	1.98	2.00	5.90	6.00	4.01	4.03	4.06	4.06	3.94	7.87
31	2.10	2.15	.00	.00	2.07	2.11	2.15	.00	2.06	2.10
32	4.45	2.29	2.21	2.25	2.30	.00	.00	2.18	2.22	2.28
33	2.35	4.72	4.74	4.84	4.88	2.32	2.32	2.33	2.36	2.38
34	2.54	2.60	2.49	2.49	.00	4.98	5.01	5.04	5.04	5.10
35	.00	.00	2.67	2.72	.00	.00	.00	.00	.00	.00
36	.00	.00	.00	.00	2.76	2.80	2.81	2.86	2.87	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	2.92
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	62.12	65.50	69.72	72.70	71.25	74.35	77.38	80.62	81.81	88.05

TABLE 2.[illegible]:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 6 AREA: 2.35 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	2.13	5.53	4.26	1.70	2.98	5.11	9.36	14.89	3.83	.00
5	2.55	2.98	5.53	5.11	2.55	2.13	4.26	8.51	15.32	.00
6	.43	1.70	2.98	5.53	7.66	3.83	3.40	3.40	8.94	8.94
7	.85	.43	.85	2.13	3.40	6.38	4.26	4.26	2.55	16.60
8	.85	1.28	1.70	1.28	.43	2.55	4.68	5.11	4.68	5.11
9	.00	.00	.43	.85	2.55	1.70	1.70	2.13	4.26	3.83
10	.43	.00	.00	.43	.00	1.28	2.13	.85	1.70	4.26
11	.00	.43	.43	.43	.85	.43	.43	2.13	1.28	1.70
12	1.70	.43	.00	.43	.00	.85	.43	.85	1.28	2.55
13	1.70	2.55	2.55	1.70	1.70	1.28	1.70	.85	.43	.43
14	1.70	1.28	1.28	1.70	2.13	2.55	2.13	2.98	3.40	2.55
15	1.28	1.28	1.28	.85	.43	.00	.85	1.28	1.70	1.70
16	2.55	2.55	2.13	2.13	1.70	2.13	1.70	.85	.85	.85
17	5.53	4.68	1.70	1.28	1.70	1.28	1.70	1.28	1.28	2.13
18	2.13	2.98	5.11	4.26	1.70	1.70	1.70	2.13	2.55	1.28
19	2.98	2.13	2.13	3.40	4.68	3.40	2.55	2.13	1.70	2.55
20	1.70	2.13	2.98	2.13	2.98	3.40	4.26	3.83	2.55	2.55
21	1.70	1.70	1.70	2.13	2.55	2.55	1.70	2.55	2.98	3.40
22	1.28	1.70	1.70	2.55	2.98	2.98	2.98	1.70	2.55	1.70
23	1.70	2.13	2.13	.85	.00	1.28	2.13	2.55	2.13	2.13
24	1.28	1.28	1.70	2.98	2.98	.85	.43	1.28	2.13	2.13
25	.85	.43	.85	.85	1.28	2.13	2.55	2.13	1.70	2.13
26	.00	.85	.85	.85	.43	1.28	.85	1.70	1.70	2.13
27	.43	.43	.00	.43	1.28	1.28	.85	.85	.85	1.70
28	.00	.00	.43	.43	.43	.43	1.28	1.28	1.70	1.28
29	.43	.43	.43	.00	.00	.00	.00	.00	.00	.43
30	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
31	.85	.43	.00	.00	.00	.00	.00	.00	.00	.00
32	.43	.85	1.28	.85	.85	.43	.00	.00	.00	.00
33	.00	.00	.00	.43	.43	.43	.85	.85	.43	.43
34	.43	.00	.00	.00	.00	.00	.00	.00	.43	.43
35	.43	.85	.85	.00	.00	.00	.00	.00	.00	.00
36	.43	.43	.43	.85	.85	.85	.43	.00	.00	.00
37	.43	.43	.00	.43	.43	.43	.85	1.28	1.28	1.28
38	.00	.00	.43	.43	.43	.43	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	39.15	44.26	48.08	49.36	52.34	55.32	62.13	73.62	76.17	76.17

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.19	.49	.38	.16	.26	.46	.85	1.33	.38	.00
5	.36	.41	.76	.70	.38	.30	.59	1.19	2.05	.00
6	.09	.34	.57	.12	1.57	.76	.73	.67	1.78	1.89
7	.21	.13	.20	.58	.96	1.70	1.18	1.16	.66	4.41
8	.30	.46	.64	.45	.14	.91	1.58	1.86	1.63	1.77
9	.00	.00	.21	.37	1.18	.75	.79	.92	1.91	1.66
10	.24	.00	.00	.21	.00	.72	1.21	.47	.94	2.41
11	.00	.26	.30	.26	.58	.29	.29	1.38	.87	1.11
12	1.39	.35	.00	.34	.00	.67	.36	.69	.98	2.08
13	1.57	2.33	2.37	1.63	1.61	1.22	1.59	.83	.40	.42
14	1.84	1.35	1.35	1.80	2.31	2.80	2.28	3.22	3.68	2.80
15	1.62	1.59	1.60	1.06	.54	.00	1.00	1.54	2.16	2.11
16	3.54	3.63	3.02	3.04	2.42	3.03	2.45	1.23	1.19	1.17
17	8.71	7.52	2.77	2.01	2.66	2.04	2.76	1.97	1.97	3.32
18	3.77	5.30	8.91	7.68	3.03	2.99	3.06	3.74	4.60	2.26
19	5.81	4.24	4.19	6.70	9.14	6.80	5.16	4.21	3.42	4.99
20	3.81	4.58	6.48	4.65	6.47	7.41	9.41	8.39	5.65	5.61
21	4.13	4.05	4.06	5.08	6.25	6.15	4.10	6.12	7.08	8.08
22	3.36	4.41	4.43	6.65	7.96	7.94	8.01	4.53	6.77	4.56
23	4.91	6.19	6.27	2.50	.00	3.65	6.17	7.26	6.13	6.22

24	3.96	4.00	5.36	5.40	9.53	2.75	1.39	4.01	6.71	6.63
25	2.95	1.42	2.91	3.88	4.29	7.13	8.68	7.25	5.91	7.32
26	.00	3.07	3.20	3.22	1.56	4.66	3.11	6.29	6.34	7.77
27	1.73	1.76	.00	1.69	5.09	5.20	3.40	3.45	3.40	6.84
28	.00	.00	1.79	1.81	1.81	1.81	5.38	5.46	7.28	5.43
29	1.98	1.98	1.98	.00	.00	.00	.00	.00	.00	1.99
30	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
31	4.53	2.27	.00	.00	.00	.00	.00	.00	.00	.00
32	2.38	4.72	7.07	4.64	4.72	2.45	.00	.00	.00	.00
33	.00	.00	.00	2.47	2.48	2.53	4.99	5.09	2.53	2.59
34	2.75	.00	.00	.00	.00	.00	.00	.00	2.62	2.68
35	2.78	5.62	5.78	.00	.00	.00	.00	.00	.00	.00
36	2.97	3.02	3.08	5.92	5.98	6.15	3.08	.00	.00	.00
37	3.23	3.26	.00	3.13	3.16	3.18	6.30	9.50	9.62	9.70
38	.00	.00	3.32	3.32	3.33	3.33	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	75.09	78.76	82.98	85.52	89.40	89.76	89.91	93.75	98.63	107.84

TABLE [illegible]:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 7 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	11.60	14.80	14.40	4.40	1.20	4.40	16.40	16.80	11.60	.00
5	8.40	12.00	12.40	14.00	8.80	5.20	6.80	16.80	15.20	.00
6	8.40	6.40	8.40	2.40	11.20	10.00	7.20	6.80	17.60	16.00
7	4.80	8.00	9.60	9.20	9.60	9.60	9.20	7.60	5.60	19.60
8	2.40	4.00	7.20	9.20	8.80	10.80	12.80	10.80	10.00	17.20
9	2.40	2.00	3.60	6.00	8.40	7.60	6.80	10.80	12.80	11.60
10	1.20	2.80	2.00	3.20	6.80	8.40	8.80	6.80	8.00	11.60
11	1.20	.80	2.40	.00	2.40	3.20	5.20	8.40	8.00	7.60
12	.80	.80	1.60	2.40	1.60	2.40	4.00	3.60	4.80	6.40
13	.40	1.20	.80	1.60	2.40	2.80	1.20	2.80	3.60	4.80
14	.00	.40	1.20	1.60	.80	1.20	3.20	2.80	2.40	3.20
15	.00	.00	.40	.40	1.60	.80	.40	1.20	2.40	2.00
16	.00	.00	.00	.40	.80	1.20	1.20	1.20	.80	2.00
17	.40	.00	.00	.00	.00	.80	1.20	.80	1.20	.40
18	.40	.40	.00	.00	.00	.00	.00	.80	.80	1.60
19	.40	.40	.80	.40	.00	.00	.00	.00	.40	1.20
20	.00	.40	.00	.40	.80	.40	.40	.40	.00	.00
21	.40	.40	.80	.40	.00	.40	.40	.00	.40	.40
22	.00	.00	.00	.40	.80	.80	.40	.80	.80	.80
23	1.20	1.20	.80	.80	.40	.40	.80	.80	.40	.00
24	1.20	1.20	1.20	1.20	1.60	.80	.80	.80	.40	.80
25	1.20	.80	.80	.40	.40	.80	.40	.40	.80	.80
26	.40	.80	.80	.80	.40	.40	.80	.80	.80	.40
27	.40	.40	.40	.80	1.20	1.20	.80	.80	.80	.80
28	.40	.00	.40	.40	.40	.00	.40	.40	.40	.40
29	1.20	1.20	.80	.80	.00	.40	.40	.40	.00	.00
30	1.20	1.20	1.60	1.20	2.00	2.00	1.60	1.60	1.20	.80
31	.80	1.20	.40	.80	.40	.40	.80	.80	1.20	1.60
32	.40	.40	1.20	.80	1.20	1.20	1.20	1.20	1.20	1.20
33	.40	.40	.40	.80	.80	.40	.40	.00	.00	.00
34	.00	.00	.00	.00	.00	.00	.00	.40	.40	.40
35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	52.40	64.00	74.80	65.60	75.20	78.40	94.40	108.00	114.40	114.00

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.95	1.25	1.24	.44	.12	.38	1.41	1.52	1.11	.00
5	1.10	1.70	1.69	.92	1.28	.78	.92	2.34	2.10	.00
6	1.71	1.27	1.68	2.10	2.20	2.03	1.46	1.36	3.50	3.36
7	1.26	2.18	2.58	3.48	2.63	2.60	2.48	2.08	1.48	5.26
8	.84	1.35	2.59	3.24	3.06	3.77	4.49	3.86	3.56	6.01
9	1.08	.88	1.57	2.66	3.75	3.42	2.98	4.73	5.67	5.15
10	.69	1.57	1.10	1.73	3.69	4.62	4.81	3.73	4.34	6.35
11	.80	.55	1.62	1.31	1.62	2.15	3.37	5.57	5.35	5.00
12	.61	.62	1.26	1.83	1.30	1.86	3.16	2.87	3.78	5.05
13	.39	1.05	.74	1.43	2.20	2.65	1.11	2.56	3.36	4.52
14	.00	.44	1.23	1.75	.83	1.25	3.42	3.08	2.58	3.49
15	.00	.00	.50	.49	1.96	.97	.50	1.44	2.97	2.44
16	.00	.00	.00	.55	1.14	1.64	1.65	1.73	1.12	2.76
17	.67	.00	.00	.00	.00	1.25	1.90	1.25	1.88	.60
18	.73	.72	.00	.00	.00	.00	.00	1.41	1.43	2.75
19	.82	.76	1.60	.82	.00	.00	.00	.00	.77	2.41
20	.00	.87	.00	.86	1.76	.89	.90	.92	.00	.00
21	.96	.98	1.92	.99	.00	.95	.98	.00	.95	1.01
22	.00	.00	.00	1.02	2.07	2.15	1.06	2.09	2.13	2.20
23	3.43	3.48	2.33	2.35	1.14	1.14	2.26	2.29	1.18	.00
24	3.74	3.82	3.78	3.87	5.10	2.50	2.51	2.52	1.22	2.46
25	4.10	2.76	2.74	1.37	1.41	2.74	1.32	1.32	2.66	2.66
26	1.47	2.96	2.95	2.94	1.44	1.47	2.93	2.95	3.01	1.51
27	1.61	1.65	1.57	3.13	4.72	4.81	3.16	3.18	3.20	3.19
28	1.76	.00	1.71	1.75	1.77	.00	1.67	1.70	1.71	1.75
29	5.53	5.52	3.73	3.78	.00	1.81	1.81	1.81	.00	.00
30	5.92	5.88	7.89	5.89	9.83	9.94	7.93	7.97	6.01	3.98
31	4.23	6.36	2.14	4.21	2.08	2.10	4.14	4.17	6.24	8.36
32	2.22	2.25	6.62	4.41	6.65	6.66	6.66	6.70	6.72	6.74
33	2.35	2.35	2.35	4.67	4.71	2.40	2.45	.00	.00	.00
34	.00	.00	.00	.00	.00	.00	.00	2.48	2.52	2.58
35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	2.83	2.84	2.87	2.89	2.89	2.89	2.89	2.89	2.89	2.89
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	51.82	56.07	62.01	66.88	71.37	71.84	76.35	82.51	85.44	94.48

TABLE 2.8:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 8 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	2.40	4.40	3.60	2.00	2.40	3.20	6.40	10.40	1.60	.00
5	3.60	3.20	4.40	3.60	2.00	3.60	4.40	6.40	9.60	.00
6	2.00	2.00	3.20	4.40	5.20	3.20	2.80	5.60	7.20	5.60
7	2.40	2.40	2.80	3.20	4.00	4.40	4.00	3.20	5.20	12.00
8	1.60	1.60	2.00	2.80	2.00	2.40	4.40	5.20	4.40	7.20
9	2.40	2.80	2.00	1.60	2.00	2.80	1.20	1.20	3.60	4.40
10	.40	1.60	1.60	2.00	1.60	1.20	3.20	2.00	1.20	2.40
11	1.60	.80	2.40	2.00	2.00	3.20	1.60	2.40	2.80	1.20
12	2.40	2.40	1.60	2.00	2.80	2.80	2.80	3.20	4.00	4.80
13	1.20	1.20	1.60	2.00	2.40	.80	2.40	2.80	2.00	2.40
14	1.20	1.60	2.00	2.00	1.60	2.40	2.40	1.20	1.20	2.40
15	.80	.80	.00	.40	1.20	1.20	.80	2.40	2.40	1.20
16	1.60	1.20	1.20	1.20	.00	.40	.80	.80	1.20	2.80
17	1.20	1.60	2.40	2.00	2.80	2.00	2.00	1.60	1.20	.40
18	2.80	1.60	.80	.80	.80	1.20	1.20	1.20	1.60	1.60
19	.40	2.00	2.80	2.40	2.00	1.60	1.20	1.20	1.60	1.60
20	2.00	.80	.40	.80	1.20	2.00	2.40	2.00	.80	.40
21	4.00	4.80	3.60	2.80	2.00	1.20	1.20	1.20	2.00	2.40
22	3.60	2.40	3.60	4.00	4.00	3.20	2.40	2.00	1.20	.80
23	1.20	2.00	1.60	2.40	3.20	4.40	4.00	4.40	4.00	3.20
24	2.00	2.00	2.40	2.00	1.60	1.60	2.40	2.40	3.60	4.00
25	1.60	2.40	2.40	2.40	2.40	1.20	1.20	.80	.80	1.60
26	1.20	.40	.80	.40	.80	2.40	2.40	2.40	2.00	1.60
27	1.20	1.60	1.60	1.20	1.60	1.20	1.20	1.20	1.60	1.60
28	.80	.40	.00	.80	.80	.80	.80	1.20	1.20	2.00
29	.00	.80	1.20	.40	.40	.00	.00	.00	.00	.00
30	.40	.40	.40	1.20	.40	.40	.40	.40	.40	.40
31	.00	.00	.00	.40	.80	.80	.80	.40	.40	.00
32	.40	.40	.00	.00	.00	.40	.00	.00	.00	.40
33	.00	.00	.40	.40	.40	.40	.80	.00	.00	.00

34	.40	.40	.40	.00	.00	.00	.00	.80	.80	.40
35	.00	.00	.00	.40	.40	.40	.40	.00	.00	.40
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.40	.40	.40	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	47.60	50.80	54.00	54.40	55.20	57.20	62.40	70.40	70.00	69.60

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.20	.39	.33	.19	.22	.29	.57	.92	.16	.00
5	.50	.47	.59	.51	.28	.51	.64	.87	1.26	.00
6	.43	.40	.63	.83	1.04	.66	.55	1.11	1.38	1.14
7	.64	.65	.74	.87	1.10	1.22	1.06	.86	1.33	3.29
8	.56	.54	.75	.98	.75	.83	1.51	1.87	1.53	2.50
9	1.11	1.25	.94	.75	.85	1.29	.55	.53	1.54	1.99
10	.23	.89	.85	1.12	.86	.62	1.74	1.09	.66	1.25
11	1.11	.56	1.61	1.31	1.30	2.14	1.09	1.56	1.91	.79
12	1.89	1.91	1.31	1.56	2.14	2.26	2.15	2.45	3.19	3.86
13	1.14	1.09	1.45	1.82	2.22	.74	2.19	2.60	1.90	2.25
14	1.30	1.67	2.14	2.19	1.74	2.57	2.66	1.31	1.28	2.67
15	1.00	1.00	.00	.47	1.47	1.47	.98	2.92	2.92	1.49
16	2.27	1.72	1.64	1.75	.00	.54	1.09	1.15	1.65	3.95
17	1.91	2.48	3.79	3.19	4.44	3.21	3.27	2.65	1.96	.67
18	5.00	2.85	1.47	1.46	1.44	2.07	2.13	2.13	2.80	2.86
19	.75	3.81	5.45	4.70	4.00	3.18	2.35	2.34	3.18	3.17
20	4.42	1.75	.90	1.71	2.55	4.37	5.27	4.50	1.82	.86
21	9.55	11.58	8.79	6.86	4.89	2.94	2.97	2.91	4.74	5.80
22	9.61	6.36	9.50	10.71	10.69	8.54	6.44	5.35	3.22	2.13
23	3.54	5.71	4.59	6.93	9.21	12.75	11.48	12.76	11.57	9.34
24	6.37	6.25	7.51	6.40	5.09	5.03	7.40	7.56	11.35	12.65
25	5.38	8.16	8.23	8.35	8.36	4.11	4.15	2.76	2.78	5.42
26	4.50	1.49	3.01	1.53	2.96	8.71	8.78	8.80	7.36	5.83
27	4.78	6.33	6.48	4.81	6.46	4.85	4.90	4.82	6.43	6.40
28	3.51	1.76	.00	3.35	3.37	3.42	3.43	5.17	5.24	8.64
29	.00	3.59	5.61	1.86	1.89	.00	.00	.00	.00	.00
30	1.98	2.00	2.03	5.94	1.99	1.91	1.91	1.94	1.95	1.98
31	.00	.00	.00	2.06	4.22	4.13	4.15	2.11	2.14	.00
32	2.28	2.30	.00	.00	.00	2.23	.00	.00	.00	2.21
33	.00	.00	2.33	2.38	2.39	2.43	4.80	.00	.00	.00
34	2.57	2.58	2.60	.00	.00	.00	.00	4.96	5.00	2.55
35	.00	.00	.00	2.63	2.64	2.66	2.66	.00	.00	2.67
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	3.02	3.04	3.04	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	85.12	88.17	91.87	92.76	94.07	95.14	96.47	93.54	95.84	101.93

TABLE [illegible]:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 9 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	3.20	9.20	5.20	3.20	2.40	5.60	15.20	21.60	10.40	.00
5	5.60	5.60	10.80	7.20	5.20	5.60	6.80	15.60	19.60	.00
6	4.00	4.40	4.40	2.60	8.00	6.00	6.00	7.20	18.00	20.00
7	4.00	3.20	2.80	4.00	5.60	6.00	6.00	5.20	3.60	21.20
8	3.20	4.00	2.00	2.00	4.80	6.80	6.40	6.80	7.60	13.60
9	3.20	3.60	5.20	1.40	2.00	2.40	4.00	3.60	5.20	4.40
10	.00	2.40	2.40	4.80	4.00	1.20	2.40	4.40	4.00	5.20
11	1.60	.40	3.60	2.40	3.20	3.20	2.80	1.20	2.80	4.00
12	.40	1.20	.80	3.60	2.80	4.40	4.40	4.80	2.80	4.00
13	.40	.80	.40	.80	3.60	4.00	2.80	2.80	3.60	2.80

14	1.20	1.20	2.00	.80	.40	2.00	1.60	3.60	3.60	2.80
15	.40	.40	.80	1.60	1.20	.40	.80	2.80	3.20	4.80
16	1.60	1.20	.40	.80	1.20	1.60	1.20	.80	1.20	1.60
17	.80	1.20	2.00	.80	1.20	.80	1.20	.80	1.60	2.40
18	1.20	.40	.40	1.60	.80	1.60	.80	1.60	1.20	.80
19	1.20	1.60	.40	.00	.80	.80	1.60	1.20	1.60	1.20
20	2.00	.40	1.60	1.60	.40	.00	.00	.40	.40	1.20
21	.40	2.40	1.20	1.60	2.00	1.60	.80	.80	.40	.80
22	.00	.00	1.20	.80	.80	1.60	1.60	1.60	1.20	1.20
23	1.60	1.60	1.20	1.20	1.60	1.20	2.00	1.60	1.60	1.20
24	.80	.40	.40	.80	1.20	.80	.80	1.20	1.60	.80
25	.40	.80	.80	.80	.80	1.60	1.60	1.60	2.00	1.60
26	.40	.40	.40	.00	.00	.00	.00	.00	.00	1.60
27	.80	.40	.80	1.20	1.20	.80	.80	.40	.40	.40
28	.00	.40	.00	.00	.00	.40	.40	.00	.00	.00
29	1.20	.80	.80	.00	.00	.00	.00	.40	.40	.00
30	.40	.40	.80	1.20	1.20	.80	.80	.80	.80	.80
31	.40	.80	.80	.40	.00	.40	.40	.00	.00	.40
32	.00	.00	.00	.40	.80	.80	.80	1.20	.00	.00
33	.40	.00	.00	.00	.00	.00	.00	.00	.80	.40
34	.00	.40	.40	.40	.00	.00	.00	.00	.00	.00
35	.00	.00	.00	.00	.40	.40	.40	.40	.40	.40
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.40
37	.40	.40	.40	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.40	.40	.40	.40	.40	.40	.40
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.40	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.40	.40	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.40	.40	.40	.40	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.40	.40	.40
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	41.60	50.80	54.80	56.80	58.40	63.60	77.20	95.20	100.80	100.80

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.32	.80	.49	.29	.23	.50	1.38	1.93	1.04	.00
5	.77	.78	1.50	1.02	.74	.79	.93	2.15	2.69	.00
6	.74	.86	.88	1.89	1.62	1.23	1.17	1.42	3.55	4.21
7	1.08	.83	.76	1.08	1.50	1.61	1.65	1.47	.96	5.70
8	1.11	1.43	.67	.70	1.60	2.42	2.26	2.46	2.69	4.73
9	1.44	1.61	2.30	1.11	.89	1.09	1.76	1.60	2.36	1.97
10	.00	1.34	1.34	2.59	2.28	.64	1.28	2.37	2.22	2.82
11	1.08	.26	2.38	1.64	2.12	2.07	1.94	.80	1.84	2.59
12	.34	.96	.60	2.78	2.22	3.33	3.46	3.80	2.22	3.17
13	.36	.74	.36	.72	3.30	3.73	2.63	2.59	3.27	2.60
14	1.25	1.30	2.15	.90	.46	2.13	3.83	3.87	3.95	2.98
15	.48	.50	1.02	1.94	1.49	.48	.96	3.35	3.93	5.93
16	2.24	1.75	.58	1.12	1.66	2.28	1.73	1.17	1.65	2.23
17	1.27	1.92	3.24	1.31	1.94	1.23	1.92	1.25	2.54	3.80
18	2.17	.71	.73	2.84	1.45	2.83	1.37	2.82	2.14	1.39
19	2.35	3.21	.81	.00	1.54	1.54	3.12	2.35	3.21	2.33
20	4.50	.84	3.44	3.57	.90	.00	.00	.84	.88	2.63
21	.93	5.69	2.87	3.89	4.89	3.90	1.94	1.97	.99	1.96
22	.00	.00	3.09	2.13	2.07	4.22	4.15	4.22	3.16	3.22
23	4.57	4.67	3.53	3.48	4.60	3.51	5.78	4.71	4.62	3.55
24	2.59	1.31	1.25	2.50	3.80	2.47	2.51	3.81	5.05	2.47
25	1.34	2.74	2.72	2.75	2.78	5.46	5.53	5.58	7.02	5.43
26	1.47	1.50	1.47	.00	.00	.00	.00	.00	.00	5.75
27	3.20	1.60	3.15	4.70	4.78	3.19	3.20	1.58	1.59	1.59
28	.00	1.71	.00	.00	.00	1.70	1.75	.00	.00	.00
29	5.61	3.75	3.67	.00	.00	.00	.00	1.83	1.86	.00
30	2.00	1.91	3.89	5.84	5.96	3.97	3.98	3.98	3.98	3.98
31	2.12	4.19	4.26	2.16	.00	2.07	2.14	.00	.00	2.06
32	.00	.00	.00	2.18	4.41	4.45	4.47	6.73	.00	.00
33	2.43	.00	.00	.00	.00	.00	.00	.00	4.74	2.42
34	.00	2.49	2.54	2.60	.00	.00	.00	.00	.00	.00
35	.00	.00	.00	.00	2.66	2.66	2.67	2.67	2.72	2.72
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	2.76
37	3.05	3.07	3.07	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	3.08	3.12	3.12	3.12	3.12	3.13	3.18
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	3.92	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	4.00	4.09	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	4.17	4.22	4.28	4.28	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	4.34	4.34	4.38
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	54.75	58.46	62.85	64.99	69.25	72.91	76.91	80.76	84.35	94.56

TABLE 2.10:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 10 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	11.60	10.80	10.00	3.20	3.20	4.40	5.20	16.80	3.60	.00
5	11.60	10.40	12.00	10.80	6.80	5.60	6.80	7.20	18.40	.00
6	6.40	10.00	10.00	13.60	12.40	7.60	5.20	7.20	10.80	15.20
7	4.00	5.60	8.00	7.60	10.00	12.40	12.00	6.00	4.80	14.40
8	8.80	4.80	5.20	7.60	7.60	8.00	10.40	13.60	10.80	12.40
9	4.00	8.40	4.40	3.60	5.20	8.00	7.60	7.20	10.80	8.80
10	2.40	3.60	7.20	6.00	5.20	4.40	6.00	8.00	5.60	6.40
11	.80	2.00	5.60	7.20	6.00	5.20	4.80	4.00	7.60	10.00
12	.00	.80	1.20	4.40	6.40	4.80	5.60	6.00	2.40	6.40
13	.40	.40	.80	2.00	3.60	5.60	5.60	4.00	8.40	3.20
14	.00	.00	.80	.80	2.40	5.20	3.20	6.00	1.60	5.60
15	.80	.40	.00	.40	.40	.40	4.00	4.00	5.20	4.40
16	.80	.80	.40	.40	.40	.80	.00	2.00	4.40	3.60
17	.00	.40	.80	.40	.80	.80	1.20	.80	1.20	4.00
18	.40	.40	.80	.40	.40	.00	.40	.80	.80	1.20
19	.40	.40	.00	.80	.40	.80	.80	.40	.40	.80
20	1.60	.80	.80	.80	1.20	.80	.40	.40	.80	1.20
21	1.20	1.20	1.60	.80	.00	.40	.40	.40	.40	.40
22	1.20	2.00	.00	.40	1.20	1.20	1.20	1.20	.80	.80
23	.40	.40	1.60	1.60	.80	.40	.80	.80	1.20	.00
24	.40	.40	.40	.40	1.20	1.20	1.20	1.20	.80	1.60
25	.00	.00	.80	.80	.80	.80	.40	.00	.40	.80
26	2.40	1.60	.40	.00	.00	.40	.40	.80	.80	.40
27	2.40	2.80	4.00	3.60	2.80	2.40	2.40	2.00	1.60	1.60
28	.40	.40	.40	1.20	1.60	2.00	1.60	1.60	1.20	1.20
29	.80	1.20	1.20	.80	.40	.00	.40	.80	1.20	1.20
30	.40	.40	.00	.40	.80	.80	.80	.80	.40	.40
31	.40	.40	.40	.40	.40	.00	.00	.00	.40	.80
32	.40	.40	.80	.40	.40	.80	.80	.80	.80	.00
33	.40	.40	.40	.40	.40	.40	.00	.00	.00	.80
34	.00	.00	.00	.40	.40	.40	.80	.80	.40	.00
35	.00	.00	.00	.00	.00	.00	.00	.00	.40	.80
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	64.80	71.60	80.00	81.60	83.60	86.00	90.40	105.60	108.40	108.40

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	1.07	.98	.92	.29	.29	.41	.44	1.56	.34	.00
5	1.64	1.47	1.66	1.48	.96	.78	.91	1.00	2.50	.00
6	1.29	1.93	1.97	2.72	2.56	1.59	1.00	1.36	2.13	3.25
7	1.09	1.50	2.18	1.96	2.69	3.39	3.32	1.67	1.30	3.85
8	3.10	1.75	1.89	2.67	2.68	2.76	3.61	4.77	3.81	4.41
9	1.73	3.76	2.06	1.58	2.28	3.57	3.41	3.13	4.85	3.96
10	1.27	1.94	4.06	3.27	2.82	2.39	3.25	4.37	3.14	3.48
11	.52	1.29	3.73	4.87	4.04	3.47	3.24	2.60	4.96	6.66
12	.00	.63	.96	3.51	5.14	3.77	4.46	4.82	1.90	5.02
13	.37	.39	.73	1.84	3.39	5.08	5.34	3.59	7.80	3.06
14	.00	.00	.82	.86	2.55	5.70	3.39	6.50	1.75	5.88
15	.99	.52	.00	.47	.49	.48	4.86	4.96	6.29	5.46
16	1.18	1.18	.57	.59	.53	1.14	.00	2.72	6.10	5.09
17	.00	.62	1.27	.61	1.24	1.28	1.85	1.26	1.84	6.26
18	.70	.72	1.45	.69	.72	.00	.69	1.41	1.41	2.08
19	.79	.81	.00	1.57	.80	1.57	1.60	.80	.78	1.54
20	3.51	1.75	1.69	1.72	2.62	1.77	.86	.85	1.68	2.64
21	2.88	2.86	3.88	2.00	.00	.97	.93	.93	.95	1.00
22	3.19	5.33	.00	1.03	3.14	3.21	3.16	3.25	2.15	2.17
23	1.15	1.19	4.52	4.67	2.37	1.17	2.32	2.37	3.56	.00
24	1.30	1.31	1.24	1.27	3.77	3.73	3.77	3.83	2.56	5.02
25	.00	.00	2.68	2.72	2.76	2.72	1.37	.00	1.32	2.72
26	9.01	6.06	1.49	.00	.00	1.43	1.44	2.95	3.00	1.50
27	9.58	11.17	16.04	14.40	11.24	9.67	9.70	8.08	6.46	6.44
28	1.76	1.66	1.67	5.06	6.85	8.65	6.95	6.92	5.19	5.19
29	3.66	5.52	5.63	3.80	1.90	.00	1.78	3.62	5.44	5.53
30	1.96	2.00	.00	1.92	3.90	3.99	4.01	4.06	2.03	1.91
31	2.14	2.16	2.06	2.08	2.14	.00	.00	.00	2.04	4.19
32	2.23	2.28	4.51	2.22	2.23	4.44	4.45	4.48	4.55	.00
33	2.35	2.35	2.40	2.35	2.39	2.43	.00	.00	.00	4.71

34	.00	.00	.00	2.46	2.51	2.55	5.03	5.07	2.54	.00
35	.00	.00	.00	.00	.00	.00	.00	.00	2.64	5.28
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	60.45	65.14	72.06	76.66	81.01	84.11	87.16	92.94	97.02	108.31

TABLE 2.11:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 11 AREA: 2.35 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.85	1.70	2.98	.85	.43	1.28	2.55	6.81	2.55	.00
5	2.13	.43	1.70	.43	.85	.43	1.28	2.55	6.81	.00
6	2.55	1.70	1.28	3.40	1.28	1.28	.85	.85	1.70	5.53
7	.43	3.40	1.28	1.28	2.98	1.28	1.28	.85	1.28	3.40
8	1.70	1.28	2.98	1.28	1.28	2.55	2.13	1.28	1.28	2.13
9	.43	.43	1.70	3.40	2.55	2.13	2.98	2.55	2.13	2.13
10	.43	.85	.00	1.28	2.13	2.13	2.13	1.70	1.70	2.55
11	1.28	.00	.85	.00	.43	1.70	1.28	1.28	1.28	1.70
12	.43	1.70	1.70	1.70	1.28	.85	1.28	.43	1.28	1.28
13	2.13	1.28	.85	.85	1.28	1.70	1.70	1.28	.85	.85
14	2.13	2.13	1.70	1.28	1.28	.85	.85	.43	.85	1.28
15	1.70	2.13	1.28	2.55	1.70	2.55	2.55	2.13	1.28	.85
16	1.28	.85	2.13	.85	1.70	1.28	.85	2.13	3.40	1.70
17	2.13	2.13	1.28	1.70	1.28	.85	1.70	.85	.43	2.98
18	3.40	2.55	3.83	2.98	1.70	.85	.43	.85	1.28	1.28
19	3.40	4.26	2.98	2.98	2.98	3.83	2.98	2.55	1.28	.85
20	2.98	2.55	3.83	3.83	3.83	3.83	4.68	4.26	3.40	1.70
21	.85	2.13	1.28	2.55	3.40	2.98	2.98	2.98	4.26	4.68
22	2.13	1.70	2.55	2.13	2.13	2.55	2.98	2.98	3.83	3.40
23	.85	1.28	1.70	1.70	2.55	2.13	1.28	2.13	2.13	3.40
24	2.13	1.70	1.28	1.28	1.28	2.13	2.98	3.40	1.70	1.70
25	1.28	1.70	1.70	2.13	1.70	1.70	.85	.43	2.13	3.40
26	.85	.85	.85	.85	1.28	1.70	2.13	2.55	2.13	1.28
27	.85	.85	.85	.85	.43	.43	.43	.00	.43	1.28
28	.43	.00	.43	.85	1.28	1.28	.85	.85	.85	.85
29	.85	1.28	.85	.85	.85	.85	1.28	1.28	.85	.00
30	.00	.00	.43	.43	.43	.43	.43	.43	.43	1.28
31	.43	.43	.43	.43	.43	.43	.43	.43	.85	.85
32	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
33	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.43	.43	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.43	.43	.43	.43	.43	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.43	.43	.43
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	40.43	41.70	45.11	45.11	45.11	46.38	48.51	50.64	52.77	52.77

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.07	.16	.27	.09	.04	.11	.21	.62	.24	.00
5	.31	.06	.23	.06	.13	.06	.17	.35	.94	.00
6	.54	.33	.26	.65	.25	.26	.17	.17	.34	1.17
7	.11	.96	.36	.34	.80	.34	.33	.22	.34	.87
8	.61	.49	1.08	.48	.50	.87	.75	.45	.42	.77
9	.18	.20	.74	1.49	1.17	.92	1.30	1.12	.94	.89
10	.21	.47	.00	.71	1.17	1.18	1.17	.97	.92	1.38
11	.87	.00	.54	.00	.28	1.10	.82	.88	.84	1.10
12	.31	1.29	1.34	1.35	1.03	.67	.95	.36	.99	1.00
13	1.93	1.23	.80	.77	1.15	1.55	1.55	1.19	.83	.77

14	2.35	2.31	1.87	1.35	1.40	.92	.93	.45	.86	1.36
15	2.03	2.69	1.49	3.16	2.08	3.16	3.20	2.66	1.60	1.05
16	1.82	1.20	2.96	1.22	2.34	1.82	1.19	2.96	4.83	2.39
17	3.35	3.43	2.03	2.68	2.04	1.33	2.66	1.37	.71	4.59
18	6.06	4.56	6.89	5.39	3.04	1.53	.77	1.45	2.24	2.30
19	6.59	8.43	6.01	5.93	5.83	7.51	5.91	5.13	2.62	1.73
20	6.59	5.55	8.40	8.47	8.37	8.39	10.29	9.48	7.51	3.74
21	1.98	5.14	3.08	6.21	8.17	7.14	7.20	7.11	10.10	11.23
22	5.58	4.51	6.75	5.72	5.66	6.70	7.89	7.86	10.27	9.00
23	2.47	3.69	4.94	4.88	7.48	6.23	3.72	6.06	6.20	9.82
24	6.65	5.41	4.13	4.00	4.01	6.57	9.29	10.90	5.53	5.34
25	4.32	5.79	5.81	7.24	5.86	5.84	2.92	1.45	7.08	11.80
26	3.14	3.21	3.14	3.09	4.67	6.29	7.86	9.51	7.95	4.80
27	3.41	3.46	3.41	3.38	1.68	1.73	1.74	.00	1.65	5.01
28	1.87	.00	1.78	3.57	5.39	5.47	3.64	3.57	3.57	3.64
29	3.89	5.82	3.81	3.85	3.86	3.89	5.84	5.88	3.97	.00
30	.00	.00	2.05	2.06	2.09	2.12	2.12	2.12	2.05	6.22
31	2.19	2.20	2.20	2.23	2.24	2.27	2.29	2.29	4.48	4.53
32	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
33	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	3.94	3.98	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	4.04	4.07	4.11	4.11	4.13	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	4.21	4.23	4.21
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	73.35	76.59	80.41	84.46	86.86	90.07	91.01	90.79	94.26	100.73

TABLE [illegible].1[illegible]:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 2 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	2.40	1.60	2.00	1.20	.40	1.20	2.40	4.40	.40	.00
5	4.00	2.80	3.20	1.60	1.60	1.20	1.20	1.60	4.40	.00
6	1.60	3.60	2.00	4.00	3.20	2.00	1.60	1.60	2.80	3.60
7	.80	1.60	2.00	2.00	3.20	4.00	4.40	3.20	1.60	3.20
8	.80	.80	3.60	2.40	1.20	1.60	1.60	3.20	4.00	3.60
9	.40	.40	.00	2.00	2.80	2.40	3.20	1.20	1.60	3.60
10	1.20	.40	.80	.80	1.20	1.60	.40	2.80	2.00	1.60
11	.80	1.60	.40	.40	.80	1.60	2.00	.40	1.20	1.60
12	2.80	2.00	2.80	1.20	1.60	1.60	2.40	3.20	2.80	1.60
13	1.60	1.60	1.20	2.80	2.00	1.20	1.20	1.20	.80	2.00
14	1.20	2.00	2.00	.40	.80	1.20	.80	.80	2.00	2.00
15	3.60	2.00	2.40	2.80	2.40	1.60	1.60	1.20	.80	.80
16	2.40	3.20	2.40	2.00	2.40	2.40	2.40	2.80	2.40	1.60
17	1.60	2.40	2.80	3.60	2.40	2.80	2.00	2.40	1.60	2.40
18	.40	.40	.80	1.20	2.00	2.40	3.20	2.40	3.60	2.40
19	.40	.00	.40	.80	1.60	1.20	1.20	2.40	1.60	2.40
20	2.80	2.00	1.20	.80	.40	.80	.80	.80	1.20	1.60
21	.80	2.00	2.40	2.00	1.20	1.20	1.20	1.20	.80	1.20
22	2.40	1.60	.80	1.20	2.00	1.60	2.00	.80	1.20	.40
23	2.00	2.40	3.20	3.20	3.60	3.20	3.20	3.60	3.20	3.20
24	.40	.80	1.20	.80	.80	.80	.80	1.60	1.60	1.60
25	1.20	.40	.00	.80	.80	1.60	1.60	.80	1.20	2.00
26	1.60	2.00	1.60	1.20	1.20	.80	.80	.80	.80	.40
27	.00	.40	1.20	1.60	1.20	.80	.80	.80	.80	1.20
28	1.60	.80	.00	.00	.40	.80	.80	1.60	1.60	1.20
29	.40	1.20	1.60	1.60	1.20	1.20	.80	.40	.00	.40
30	.40	.40	.40	.40	.80	.80	1.20	1.20	1.20	.80
31	.80	.80	.80	.40	.40	.00	.00	.40	.80	1.20
32	.40	.40	.40	.80	.80	.80	.80	.80	.40	.40
33	.00	.00	.40	.40	.40	.80	.40	.40	.80	.40
34	.00	.00	.00	.00	.00	.00	.40	.40	.40	.80
35	.40	.40	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.00	.40	.40	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.40	.40	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.40	.40	.40	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.40
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	41.20	42.00	44.40	44.80	45.20	45.60	47.60	50.80	50.00	49.60

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.22	.14	.18	.12	.04	.10	.20	.41	.04	.00
5	.55	.38	.45	.21	.22	.18	.17	.22	.59	.00
6	.32	.74	.39	.77	.64	.39	.31	.30	.57	.75
7	.22	.45	.50	.54	.86	1.06	1.20	.87	.47	.88
8	.28	.30	1.26	.90	.45	.57	.55	1.10	1.39	1.29
9	.17	.19	.00	.89	1.24	1.06	1.46	.54	.69	1.57
10	.65	.22	.44	.47	.66	.90	.22	1.52	1.10	.91
11	.53	1.08	.27	.28	.50	1.07	1.38	.28	.79	1.03
12	2.21	1.60	2.24	.97	1.27	1.30	1.92	2.59	2.32	1.31
13	1.48	1.47	1.08	2.57	1.86	1.12	1.16	1.10	.73	1.80
14	1.26	2.13	2.19	.46	.82	1.37	.89	.82	2.08	2.13
15	4.45	2.51	3.03	3.43	2.99	2.05	2.04	1.47	.98	1.00
16	3.39	4.51	3.44	2.76	3.34	3.32	3.35	3.89	3.40	2.27
17	2.49	[illegible].79	4.45	5.73	3.84	4.49	3.18	3.85	2.55	3.78
18	.71	.73	1.41	2.15	3.39	4.24	5.65	4.27	6.47	4.34
19	.81	.00	.75	1.53	3.11	2.40	2.35	4.75	3.23	4.68
20	6.16	4.44	2.70	1.82	.92	1.79	1.77	1.81	2.62	3.49
21	1.92	4.77	5.80	4.88	2.85	2.90	2.85	2.96	1.90	2.92
22	6.39	4.34	2.12	3.17	5.26	4.27	5.38	2.15	3.16	1.09
23	5.74	6.88	9.19	9.28	10.49	9.36	9.50	10.49	9.36	9.49
24	1.25	2.49	3.80	2.55	2.61	2.46	2.50	5.04	5.08	5.01
25	4.17	1.41	.00	2.65	2.69	5.44	5.53	2.73	4.11	7.00
26	5.87	7.30	5.83	4.44	4.48	3.03	3.05	2.87	2.96	1.52
27	.00	1.57	4.71	6.35	4.82	3.24	3.26	3.09	3.13	4.77
28	6.96	3.53	.00	.00	1.66	3.35	3.40	6.77	6.90	5.28
29	1.82	5.43	7.23	7.36	5.57	5.66	3.80	1.90	.00	1.81
30	1.91	1.98	1.91	1.96	3.93	3.97	5.92	5.85	5.86	3.90
31	4.23	4.29	4.22	2.11	2.16	.00	.00	2.04	4.14	6.34
32	2.26	2.30	2.19	4.43	4.43	4.44	4.47	4.52	2.25	2.26
33	.00	.00	2.35	2.39	2.45	4.77	2.35	2.40	4.77	2.42
34	.00	.00	.00	.00	.00	.00	2.48	2.49	2.55	5.12
35	2.66	2.73	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.00	2.83	2.91	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	2.99	3.04	.00	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	3.10	3.15	3.22	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	3.37
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	71.12	73.68	76.96	80.07	82.56	83.26	85.37	88.25	89.41	93.54

TABLE 2.13:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 13 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	9.20	11.20	6.80	6.40	5.20	4.40	4.80	1.60	.40	.00
5	9.60	[illegible].60	11.20	9.60	8.80	8.80	8.80	8.00	5.60	.40
6	8.80	8.00	10.80	10.00	9.60	8.00	7.60	8.80	10.40	10.00
7	3.60	[illegible].80	5.60	9.60	10.80	11.60	6.80	6.40	7.20	10.80
8	4.00	3.60	6.80	4.00	4.80	6.00	12.00	12.00	7.20	4.40
9	2.80	3.60	3.20	6.00	5.60	4.80	3.20	5.20	10.00	6.00
10	.00	1.60	2.00	2.80	4.80	6.00	7.60	5.20	4.40	10.00
11	.80	.40	2.40	2.40	3.60	4.40	3.60	4.80	5.20	4.00
12	.00	.40	.00	1.60	.80	2.00	4.00	4.80	4.40	5.20
13	.40	.00	.40	.00	.80	1.20	.80	2.00	3.20	4.00
14	.80	.80	.80	1.20	.40	.40	.80	.40	1.20	2.80
15	2.00	[illegible].00	1.20	.80	1.60	.80	.80	1.60	1.20	1.60
16	1.60	1.20	1.20	1.20	1.20	1.60	2.00	1.20	1.60	1.20
17	1.60	2.00	1.20	.00	.00	.00	.00	.80	1.20	1.60
18	2.40	2.80	1.20	2.00	1.20	.00	.00	.00	.00	.40
19	.40	.40	3.20	3.20	2.40	2.80	2.80	2.00	1.20	.80
20	1.20	.00	.40	.80	2.40	2.00	1.60	1.60	2.00	1.60
21	.80	1.60	.40	.40	.00	1.20	1.60	2.00	2.40	.80
22	1.20	1.20	2.00	1.60	1.20	1.20	.40	.80	.80	2.80
23	.40	.40	.80	1.20	1.20	.40	.80	.40	.40	.80
24	1.60	2.00	1.20	.40	1.20	1.20	1.20	1.20	.80	.40
25	2.00	1.20	.80	1.20	1.20	2.00	1.20	1.60	1.60	1.20
26	.00	.80	2.00	2.00	1.20	.80	1.60	.80	1.20	1.60
27	.80	.80	.40	.00	.80	1.20	.40	.80	.80	.80
28	1.20	1.20	1.20	1.20	1.20	1.20	2.00	1.20	.80	.80
29	1.60	1.60	.80	.80	.40	.40	.00	.80	1.20	1.20
30	.40	.40	1.60	2.00	2.40	1.60	1.60	.80	.40	.80
31	.80	.40	.40	.40	.40	1.20	.80	1.20	1.20	1.20
32	.40	.80	.00	.00	.00	.00	.40	.80	1.20	1.20
33	.40	.40	.80	.80	.80	.40	.40	.00	.00	.00

34	.80	.40	.80	.80	.40	.80	.40	.40	.40	.40
35	.00	.40	.40	.40	.80	.80	.80	1.20	.80	.40
36	.00	.00	.00	.00	.00	.00	.40	.40	.80	.80
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.40
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	61.60	68.00	72.00	74.80	77.20	79.20	81.20	80.80	81.20	80.40

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.77	1.08	.64	.61	.50	.42	.45	.17	.03	.00
5	1.31	1.33	1.53	1.34	1.25	1.23	1.28	1.14	.83	.05
6	1.72	1.56	2.18	2.00	1.95	1.63	1.54	1.72	2.05	2.08
7	.95	1.79	1.46	2.61	2.94	3.22	1.87	1.70	1.90	2.91
8	1.38	1.26	2.40	1.44	1.73	2.08	4.10	4.33	2.63	1.56
9	1.24	1.59	1.46	2.69	2.56	2.17	1.43	2.29	4.47	2.62
10	.00	.84	1.10	1.49	2.65	3.25	4.16	2.93	2.46	5.48
11	.54	.28	1.55	1.56	2.42	2.92	2.43	3.16	3.50	2.69
12	.00	.32	.00	1.22	.63	1.54	3.11	3.79	3.47	4.13
13	.39	.00	.38	.00	.70	1.16	.74	1.86	2.92	3.69
14	.82	.83	.87	1.33	.45	.46	.88	.45	1.25	2.98
15	2.46	2.52	1.52	1.02	1.96	1.00	.96	1.96	1.46	1.93
16	2.27	1.66	1.67	1.72	1.74	2.23	2.81	1.68	2.20	1.66
17	2.53	3.21	1.91	.00	.00	.00	.00	1.22	1.89	2.51
18	4.20	5.13	2.11	3.55	2.16	.00	.00	.00	.00	.71
19	.75	.76	6.26	6.39	4.72	5.46	5.61	4.05	2.45	1.63
20	2.72	.00	.86	1.74	5.25	4.35	3.54	3.50	4.38	3.55
21	2.00	3.89	.97	1.01	.00	2.80	3.80	4.79	5.89	1.87
22	3.19	3.22	5.28	4.32	3.18	3.19	1.09	2.12	2.18	7.38
23	1.19	1.12	2.33	3.50	3.51	1.17	2.31	1.13	1.16	2.34
24	4.97	6.28	3.78	1.27	3.80	3.68	3.76	3.78	2.51	1.25
25	6.96	4.24	2.65	4.09	4.13	6.84	4.09	5.47	5.45	4.12
26	.00	2.90	7.37	7.51	4.47	2.97	5.89	2.93	4.40	5.90
27	3.19	3.24	1.64	.00	3.16	4.85	1.61	3.17	3.21	3.12
28	5.12	5.22	5.17	5.07	5.12	5.16	8.55	5.14	3.42	3.43
29	7.38	7.52	3.71	3.66	1.80	1.81	.00	3.57	5.43	5.47
30	1.92	1.95	7.76	9.78	11.89	7.93	8.00	4.01	1.98	3.98
31	4.21	2.07	2.10	2.12	2.16	6.32	4.23	6.25	6.20	6.30
32	2.26	4.54	.00	.00	.00	.00	2.21	4.40	6.65	6.79
33	2.35	2.42	4.69	4.81	4.87	2.45	2.45	.00	.00	.00
34	5.06	2.49	5.01	5.13	2.58	5.13	2.58	2.46	2.48	2.49
35	.00	2.63	2.69	2.69	5.33	5.44	5.31	8.02	5.35	2.66
36	.00	.00	.00	.00	.00	.00	2.78	2.84	5.67	5.59
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	3.04
38	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	73.87	77.88	83.04	85.68	89.62	92.88	93.60	96.04	99.86	105.92

TABLE 2.14:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 14 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	3.20	4.00	1.20	2.80	2.00	5.20	8.80	16.40	6.80	.00
5	6.00	5.20	5.20	2.40	2.80	4.00	5.20	10.00	17.60	.00
6	3.60	6.80	6.40	5.20	4.80	2.40	3.20	4.00	8.40	16.80
7	1.60	1.20	4.80	5.60	6.00	7.60	6.00	3.20	3.20	14.40
8	1.20	1.60	1.20	4.00	4.00	3.60	4.40	6.40	6.00	6.00
9	.40	.80	.80	.80	3.20	3.60	4.40	2.80	3.20	6.80
10	1.20	.40	1.20	2.40	1.20	1.60	2.40	3.60	5.20	2.00
11	.00	.80	.80	.00	1.20	1.60	2.00	1.60	2.40	5.20
12	.00	.00	.40	.80	.00	.80	1.20	2.00	1.20	1.60
13	.40	.40	.40	.80	1.60	.00	.00	.80	1.20	1.20

14	.40	.00	.00	.00	.00	1.20	1.20	.00	.40	1.60
15	1.20	.80	.00	.00	.00	.00	.00	.80	.00	.00
16	.80	.80	1.20	.80	.00	.00	.00	.00	.80	.40
17	1.20	1.60	.00	.40	1.20	.80	.40	.00	.00	.40
18	.40	.80	2.40	.40	.00	.40	.80	.80	.80	.00
19	1.20	1.20	1.20	2.00	.80	.00	.00	.40	.40	1.20
20	.80	.80	.80	1.60	2.80	1.60	1.60	.80	.80	.40
21	1.20	.80	1.20	1.20	1.60	3.60	3.60	1.20	.80	.80
22	.40	.80	.40	.40	.00	.00	.00	2.40	2.40	1.20
23	.40	.80	.80	.40	.40	.40	.00	.00	.40	1.60
24	.00	.00	.40	1.20	1.60	1.20	.80	.40	.00	.40
25	.80	.40	.00	.00	.00	.40	1.20	.80	.80	.00
26	.80	.80	1.20	.80	.80	.40	.40	.80	1.20	1.60
27	.00	.40	.40	.40	.40	.80	.80	.40	.40	.80
28	1.20	1.20	.80	1.20	1.20	.40	.40	.40	.40	.40
29	1.20	.80	.40	.40	.00	.80	.80	1.20	.80	.40
30	.40	.40	1.20	1.20	.80	.80	.80	.40	.40	.00
31	.40	.80	.80	.80	1.60	1.20	1.20	1.20	1.20	1.20
32	.00	.00	.00	.00	.00	.40	.40	.80	1.20	1.60
33	.40	.40	.00	.00	.00	.00	.00	.00	.00	.00
34	.40	.40	.40	.00	.00	.00	.00	.00	.00	.00
35	.00	.00	.40	.80	.80	.80	.80	.40	.40	.40
36	1.20	.80	.80	.80	.40	.40	.00	.00	.00	.00
37	.40	.80	.80	.80	.80	.80	.80	.80	.40	.40
38	.00	.00	.00	.00	.40	.40	.40	.40	.40	.40
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	32.80	36.80	38.00	40.40	42.40	47.20	54.00	65.20	69.60	69.20

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.30	.35	.11	.26	.18	.45	.78	1.52	.65	.00
5	.84	.73	.71	.37	.35	.55	.68	1.36	2.43	.00
6	.69	1.36	1.33	1.04	1.00	.50	.63	.81	1.62	3.53
7	.43	.32	1.28	1.45	1.59	2.11	1.67	.91	.83	3.92
8	.42	.57	.43	1.39	1.39	1.27	1.49	2.27	2.15	2.07
9	.17	.33	.35	.33	1.43	1.59	1.94	1.29	1.42	3.01
10	.70	.21	.60	1.32	.68	.88	1.30	1.95	2.87	1.17
11	.00	.53	.55	.00	.79	1.04	1.34	1.02	1.62	3.41
12	.00	.00	.30	.67	.00	.61	.97	1.58	1.02	1.25
13	.39	.39	.39	.76	1.53	.00	.00	.74	1.11	1.16
14	.45	.00	.00	.00	.00	1.26	1.31	.00	.41	1.68
15	1.51	.98	.00	.00	.00	.00	.00	.99	.00	.00
16	1.16	1.15	1.65	1.15	.00	.00	.00	.00	1.08	.59
17	1.93	2.60	.00	.62	1.87	1.30	.66	.00	.00	.61
18	.74	1.41	4.26	.73	.00	.68	1.37	1.39	1.45	.00
19	2.34	2.36	2.44	3.91	1.59	.00	.00	.76	.78	2.31
20	1.77	1.76	1.75	3.46	6.08	3.43	3.53	1.75	1.76	.87
21	2.90	1.92	2.92	2.91	3.90	8.64	8.80	2.86	1.95	1.92
22	1.10	2.08	1.10	1.07	.00	.00	.00	6.15	6.30	3.15
23	1.18	2.35	2.33	1.17	1.11	1.17	.00	.00	1.14	4.59
24	.00	.00	1.22	3.68	5.04	3.89	2.49	1.23	.00	1.25
25	2.79	1.42	.00	.00	.00	1.33	4.07	2.75	2.71	.00
26	2.94	2.89	4.41	2.96	2.98	1.46	1.46	2.89	4.38	5.82
27	.00	1.57	1.63	1.54	1.59	3.17	3.18	1.59	1.61	3.19
28	5.12	5.21	3.46	5.19	5.28	1.77	1.77	1.66	1.67	1.70
29	5.50	3.76	1.81	1.86	.00	3.58	3.61	5.45	3.63	1.87
30	2.03	1.91	5.86	6.01	3.93	3.99	3.99	2.00	1.91	.00
31	2.15	4.22	4.25	4.26	8.43	6.32	6.37	6.29	6.20	6.24
32	.00	.00	.00	.00	.00	2.18	2.18	4.37	6.60	8.89
33	2.38	2.43	.00	.00	.00	.00	.00	.00	.00	.00
34	2.54	2.58	2.60	.00	.00	.00	.00	.00	.00	.00
35	.00	.00	2.64	5.31	5.33	5.35	5.35	2.75	2.75	2.75
36	8.59	5.75	5.77	5.78	2.89	2.89	.00	.00	.00	.00
37	3.00	5.93	5.99	6.04	5.94	5.96	5.96	5.97	2.95	2.95
38	.00	.00	.00	.00	3.08	3.13	3.13	3.17	3.18	3.23
39	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	56.05	59.07	62.15	65.26	68.00	70.50	70.04	67.48	68.21	73.15

TABLE 2.1[illegible]:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 16 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	7.20	6.80	7.60	5.20	6.00	8.00	9.60	9.60	2.40	.00
5	8.40	9.60	7.60	9.60	8.00	8.40	9.60	12.00	10.80	.00
6	2.80	6.40	8.40	9.20	9.60	8.00	6.80	8.40	14.00	12.00
7	.80	.80	3.60	4.80	4.80	9.20	11.20	7.60	4.80	13.60
8	1.20	.80	2.40	2.80	4.40	3.20	3.60	6.40	10.40	9.60
9	1.60	2.40	.40	2.00	2.80	3.20	3.60	4.40	4.40	6.80
10	1.20	.80	2.00	1.20	2.80	2.80	3.60	2.80	3.60	4.40
11	.80	.80	1.60	2.00	1.20	2.00	2.80	2.40	3.20	5.20
12	.40	.80	.40	1.20	2.00	1.20	1.20	3.60	1.20	1.60
13	1.60	.80	.80	.00	.00	1.20	1.60	.40	2.80	1.60
14	2.40	2.40	2.00	2.80	2.40	1.6	1.60	2.80	2.00	3.60
15	.80	1.60	1.60	.80	.80	1.20	.80	.80	1.60	1.60
16	1.60	.40	.80	1.20	1.20	1.20	1.20	1.20	.80	1.60
17	.80	1.60	1.60	1.60	.80	.80	.80	.80	1.60	.80
18	.40	.80	1.20	.40	1.60	1.20	1.20	1.20	.80	.80
19	2.80	2.00	1.20	2.40	1.60	1.20	1.60	1.20	1.60	1.60
20	1.60	2.00	2.80	2.40	2.80	3.60	2.80	2.00	1.20	.80
21	.40	.80	.80	1.20	1.20	.40	1.20	2.40	2.40	2.40
22	2.80	2.40	1.20	.80	1.20	2.00	1.60	1.60	2.00	2.40
23	.80	.80	2.00	2.00	1.20	.40	.80	.40	.80	1.60
24	2.00	2.00	2.00	2.00	2.00	2.80	2.40	2.00	2.00	.80
25	1.20	1.20	1.20	1.60	1.60	1.20	1.20	.80	.40	1.20
26	1.20	1.60	1.60	1.60	1.60	1.20	1.60	2.40	2.80	2.00
27	.80	.40	.40	.40	.40	.80	.80	.80	.80	2.00
28	1.20	1.60	1.60	.80	1.20	1.20	1.20	.80	.40	.00
29	.80	.40	.40	1.20	.80	.80	.40	.40	.00	.40
30	1.60	2.00	2.00	1.60	.80	.40	.80	.40	.80	.80
31	.40	.40	.40	.40	1.20	1.60	1.60	2.00	1.60	.80
32	.80	.80	.80	.40	.00	.00	.00	.00	.40	1.20
33	.00	.00	.00	.40	.80	.80	.80	.80	.80	.80
34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	.40	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	.80	.80	.80	.80	.80	.00	.00	.00	.00	.00
40	.00	.40	.40	.40	.00	.80	.80	.80	.80	.40
41	.00	.00	.00	.00	.40	.40	.40	.40	.40	.40
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	51.60	56.40	61.60	65.20	68.00	72.80	79.20	83.60	83.60	82.80

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.64	.60	.66	.47	.56	.72	.88	.86	.25	.00
5	1.15	1.34	1.06	1.31	1.15	1.17	1.34	1.70	1.51	.00
6	.51	1.27	1.67	1.87	1.99	1.65	1.32	1.67	2.76	2.67
7	.21	.22	.93	1.29	1.26	2.50	3.05	2.12	1.30	3.71
8	.42	.27	.83	.98	1.51	1.16	1.28	2.17	3.56	3.44
9	.68	1.12	.20	.86	1.25	1.44	1.53	1.93	1.97	3.07
10	.65	.45	1.10	.65	1.53	1.60	2.00	1.55	1.97	2.33
11	.49	.49	1.02	1.30	.82	1.26	1.89	1.51	2.09	3.40
12	.34	.63	.34	.93	1.59	.92	.92	2.88	.94	1.22
13	1.49	.75	.77	.00	.00	1.08	1.52	.40	2.54	1.46
14	2.57	2.55	2.10	2.99	2.61	1.73	1.73	3.02	2.16	3.87
15	.98	1.96	2.01	1.00	.98	1.48	1.00	1.03	1.94	1.96
16	2.31	.57	1.07	1.65	1.66	1.70	1.69	1.73	1.11	2.25
17	1.27	2.50	2.53	2.58	1.25	1.29	1.25	1.30	2.56	1.29
18	.69	1.39	2.17	.68	2.79	2.12	2.08	2.12	1.47	1.43
19	5.56	4.01	2.39	4.69	3.18	2.36	3.19	2.39	3.19	3.13
20	3.46	4.30	6.12	5.33	6.19	7.94	6.20	4.43	2.68	1.72
21	.93	1.89	1.95	2.94	2.93	.97	2.91	5.72	5.75	5.71
22	7.43	6.49	3.23	2.14	3.22	5.30	4.23	4.30	5.30	6.31
23	2.34	2.31	5.78	5.83	3.52	1.17	2.30	1.11	2.26	4.58
24	6.24	6.24	6.35	6.34	6.34	8.85	7.58	6.32	6.42	2.58
25	4.09	4.06	4.15	5.53	5.55	4.21	4.18	2.74	1.39	4.07
26	4.35	5.82	5.91	5.98	5.97	4.42	5.88	8.84	10.40	7.56
27	3.20	1.59	1.63	1.64	1.56	3.11	3.12	3.15	3.18	7.89
28	5.25	6.98	7.06	3.52	5.19	5.23	5.24	3.51	1.75	.00
29	3.67	1.81	1.83	5.52	3.71	3.76	1.89	1.90	.00	1.80
30	7.89	9.90	10.00	8.05	3.97	2.00	3.94	1.94	3.90	3.91
31	2.07	2.07	2.07	2.06	6.18	8.33	8.35	10.51	8.45	4.19
32	4.41	4.48	4.55	2.30	.00	.00	.00	.00	2.18	6.58
33	.00	.00	.00	2.32	4.69	4.71	4.71	4.72	4.72	4.75

34	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
35	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
38	3.23	.00	.00	.00	.00	.00	.00	.00	.00	.00
39	6.74	6.62	6.71	6.74	6.77	.00	.00	.00	.00	.00
40	.00	3.46	3.51	3.56	.00	6.89	6.88	6.95	6.96	3.56
41	.00	.00	.00	.00	3.61	3.67	3.67	3.67	3.67	3.63
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	85.26	88.15	91.69	93.02	93.53	94.77	97.72	98.17	100.35	103.96

TABLE 2.16:

SUMMARY FOR PLOT NO. 61 SUBPLOT NO. 27 AREA: 2.50 ACRES

STEM COUNT PER ACRE

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.40	.40	2.00	2.40	4.40	5.60	6.00	5.60	2.00	.00
5	.00	.40	.80	1.20	2.40	3.20	6.00	8.00	8.00	.00
6	.00	.00	.00	.80	1.60	1.20	1.20	2.80	4.80	7.60
7	.00	.00	.00	.00	.40	1.60	1.20	.80	2.00	6.00
8	.80	.80	.40	.00	.00	.80	1.60	1.60	1.20	2.80
9	.00	.00	.40	.80	.80	.40	.80	1.20	1.20	1.60
10	.80	.00	.00	.00	.00	.40	.40	.80	.80	1.60
11	.40	1.20	.80	.00	.00	.00	.00	.00	.80	.80
12	.40	.00	.40	.80	.40	.00	.00	.00	.00	.00
13	1.20	.80	.00	.00	.40	.40	.00	.00	.00	.40
14	.80	.40	.80	.40	.40	.00	.40	.40	.00	.00
15	2.00	2.00	.40	.80	.40	.80	.40	.00	.40	.40
16	.80	1.60	2.80	.40	.40	.40	.40	.80	.80	.40
17	2.40	.80	1.20	2.40	1.60	.80	1.20	.80	.40	.80
18	.40	2.00	1.20	.80	2.00	2.00	.80	1.20	1.20	.40
19	1.20	.80	1.20	2.00	1.20	1.20	1.60	.40	.80	1.20
20	.40	.40	.80	1.60	1.20	1.60	2.00	2.80	2.40	1.60
21	1.60	.80	.80	.40	1.20	1.60	1.20	.80	1.20	1.20
22	.40	1.60	.80	.80	.80	.40	1.20	1.20	.80	1.20
23	1.20	1.20	1.60	1.20	.80	.40	.40	1.20	1.20	.80
24	.40	.40	1.20	1.20	1.60	1.60	1.20	.80	1.20	1.20
25	2.80	1.60	.80	.80	1.20	1.20	1.20	1.20	.40	.80
26	.40	2.00	1.60	2.00	1.20	1.60	1.60	1.20	2.00	1.60
27	.40	.40	1.20	1.60	1.60	1.20	1.60	1.60	.40	.80
28	.40	.00	.40	.00	.80	1.20	.80	.80	2.00	2.00
29	.00	.40	.40	.80	.80	.80	1.20	.80	.80	.80
30	.40	.40	.40	.00	.00	.40	.40	1.20	1.20	.80
31	.40	.40	.40	.40	.40	.40	.40	.40	.40	1.20
32	1.20	.80	.80	.40	.40	.40	.40	.40	.40	.40
33	.80	.80	.80	1.20	.80	.80	.40	.40	.40	.40
34	.00	.00	.00	.00	.00	.00	.40	.40	.40	.40
35	.40	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	.40	.40	.40	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	.40	.40	.40	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	.40	.40	.40
39	.40	.40	.40	.40	.40	.40	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	23.20	23.20	25.20	26.00	30.00	33.20	36.80	40.00	40.00	39.60

BASAL AREA PER ACRE IN SQ. FT.

DIA CLASS (IN.)	1920	1925	1930	1935	1940	1945	1950	1955	1960	1970
4	.04	.03	.16	.23	.39	.51	.54	.51	.21	.00
5	.00	.05	.11	.16	.34	.40	.79	1.08	1.12	.00
6	.00	.00	.00	.15	.33	.25	.24	.54	.91	1.60
7	.00	.00	.00	.00	.10	.43	.32	.22	.53	1.59
8	.29	.31	.16	.00	.00	.27	.53	.56	.42	.98
9	.00	.00	.17	.34	.37	.18	.35	.52	.54	.69
10	.45	.00	.00	.00	.00	.21	.22	.46	.41	.90
11	.28	.82	.57	.00	.00	.00	.00	.00	.51	.55
12	.34	.00	.29	.63	.31	.00	.00	.00	.00	.00
13	1.11	.78	.00	.00	.36	.39	.00	.00	.00	.35

14	.89	.45	.86	.43	.46	.00	.41	.44	.00	.00
15	2.43	2.49	.49	.99	.50	1.00	.52	.00	.47	.52
16	1.12	2.25	3.95	.57	.55	.58	.54	1.10	1.15	.57
17	3.78	1.31	1.96	3.75	2.53	1.25	1.91	1.28	.64	1.28
18	.71	3.50	2.22	1.37	3.57	3.63	1.45	2.16	2.15	.71
19	2.42	1.60	2.31	3.92	2.45	2.42	3.16	.78	1.57	2.35
20	.92	.88	1.68	3.46	2.60	3.49	4.36	6.07	5.33	3.54
21	3.88	1.92	1.92	1.00	2.81	3.94	2.94	1.91	2.97	2.90
22	1.03	4.21	2.12	2.12	2.06	1.05	3.17	3.17	2.17	3.17
23	3.42	3.45	4.57	3.52	2.32	1.11	1.13	3.44	3.56	2.32
24	1.28	1.24	3.77	3.71	5.01	[illegible].99	3.76	2.49	3.77	3.82
25	9.58	5.54	2.80	2.68	4.17	4.06	4.06	4.09	1.36	2.72
26	1.47	7.39	5.91	7.34	4.49	6.06	[illegible].00	4.39	7.40	5.96
27	1.63	1.65	4.71	6.43	6.39	4.74	6.40	6.46	1.63	3.21
28	1.77	.00	1.77	.00	3.43	5.13	3.45	3.37	8.48	8.63
29	.00	1.82	1.85	3.71	3.78	3.71	5.57	3.64	3.69	3.73
30	1.98	1.98	1.98	.00	.00	1.94	1.96	5.85	5.96	3.86
31	2.04	2.06	2.07	2.07	2.07	2.07	2.07	2.07	2.07	6.22
32	6.70	4.51	4.54	2.28	2.29	2.29	2.30	2.30	2.30	2.30
33	4.71	4.75	4.78	7.14	4.77	4.80	2.35	2.35	2.36	2.36
34	.00	.00	.00	.00	.00	.00	2.46	2.49	2.51	2.55
35	2.75	.00	.00	.00	.00	.00	.00	.00	.00	.00
36	.00	2.81	2.84	2.91	.00	.00	.00	.00	.00	.00
37	.00	.00	.00	.00	2.97	3.00	3.07	.00	.00	.00
38	.00	.00	.00	.00	.00	.00	.00	3.13	3.15	3.23
39	3.28	3.34	3.35	3.39	3.40	3.40	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
46	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
47	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
48	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
49	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL	60.30	61.13	63.93	64.30	64.84	67.29	66.02	66.88	69.33	72.60

Section 3: COMPOSITE STAND AND STOCK TABLES

3.1: Stand Tables

TABLE 3.1.1: STAND TABLE BASED ON 1920 INVENTORY

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	4.35	.39	4.22	.00
5	4.70	.65	6.54	.00
6	3.16	.63	6.48	.00
7	1.95	.52	5.71	.00
8	2.07	.72	8.60	.00
9	1.34	.59	7.64	.00
10	.71	.39	5.51	.00
11	.88	.59	9.06	.00
12	.71	.56	9.45	28.06
13	1.01	.94	17.34	57.56
14	1.04	1.12	22.55	80.76
15	1.37	1.68	35.71	134.81
16	1.21	1.72	39.57	157.07
17	1.57	2.48	58.91	240.39
18	1.26	2.25	57.19	252.13
19	1.39	2.74	72.73	342.51
20	1.54	3.39	94.23	470.40
21	1.21	2.91	83.74	434.26
22	1.24	3.30	101.06	547.04
23	1.06	3.06	96.52	535.78
24	.99	3.09	100.99	574.25
25	1.06	3.63	122.94	714.67
26	.76	2.80	97.85	579.00
27	.68	2.73	96.70	578.98
28	.68	2.96	108.77	661.90
29	.66	3.02	111.98	685.88
30	.48	2.36	90.00	557.59
31	.43	2.26	87.65	547.36
32	.38	2.12	82.71	518.98
33	.20	1.20	47.80	302.20
34	.20	1.29	51.82	329.58
35	.08	.51	20.59	131.47
36	.13	.90	36.87	236.47
37	.10	.77	31.68	204.04
38	.05	.41	17.05	110.26
39	.08	.63	26.51	171.75
40	.03	.23	9.52	61.87
41	.03	.23	9.87	64.25
42	.03	.25	10.47	68.36
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	40.81	62.04	1904.53	10379.60

TABLE 3.1.2: STAND TABLE BASED ON 1925 INVENTORY

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	5.69	.51	5.49	.00
5	4.85	.68	6.84	.00
6	4.20	.83	8.56	.00
7	2.63	.71	7.79	.00
8	2.02	.72	8.56	.00
9	1.92	.86	11.09	.00
10	1.14	.62	8.64	.00
11	.81	.54	8.34	.00
12	.86	.68	11.28	33.37
13	.88	.82	14.99	49.93
14	1.09	1.16	23.27	83.00
15	1.19	1.48	31.86	121.17
16	1.16	1.65	37.46	147.89
17	1.59	2.54	60.74	249.17
18	1.37	2.43	61.71	271.94
19	1.29	2.55	67.72	319.57
20	1.31	2.86	79.12	392.98
21	1.69	4.08	116.81	605.87
22	1.11	2.96	90.20	487.73
23	1.24	3.58	112.35	623.27
24	1.09	3.42	111.37	633.14
25	.88	3.03	102.11	592.99
26	1.01	3.73	129.58	765.52
27	.71	2.84	101.79	611.35
28	.56	2.40	87.47	530.87
29	.83	3.84	142.21	871.02
30	.51	2.49	94.58	585.44
31	.48	2.53	98.11	612.77
32	.35	2.00	78.13	490.69
33	.23	1.35	53.77	339.94
34	.20	1.29	51.92	330.19
35	.10	.67	27.32	174.35
36	.13	.90	36.96	237.11
37	.13	.95	39.48	254.24
38	.00	.00	.00	.00
39	.10	.84	34.94	226.20
40	.05	.44	18.68	121.36
41	.03	.24	9.97	64.94
42	.00	.00	.00	.00
43	.03	.25	10.67	69.73
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	45.46	65.47	2001.87	10897.73

TABLE 3.1.3: STAND TABLE BASED ON 1930 INVENTORY

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	5.23	.47	5.06	.00
5	5.99	.82	8.33	.00
6	4.88	.98	10.10	.00
7	3.24	.86	9.45	.00
8	2.78	.99	11.86	.00
9	1.92	.86	11.15	.00
10	1.57	.87	12.11	.00
11	1.59	1.06	16.05	.00
12	.99	.78	12.99	38.86
13	.81	.75	13.72	45.74
14	1.16	1.25	25.04	89.54
15	.91	1.13	24.17	91.72
16	1.16	1.64	37.12	146.29
17	1.34	2.14	51.38	211.55
18	1.54	2.75	69.22	305.31
19	1.37	2.69	71.43	336.34
20	1.39	3.04	84.26	419.31
21	1.44	3.49	100.46	522.58
22	1.29	3.39	100.83	540.87
23	1.42	4.09	128.48	712.81
24	.99	3.11	101.14	575.09
25	1.04	3.53	117.78	681.88
26	.99	3.65	126.03	743.78
27	.86	3.43	122.69	736.12
28	.53	2.28	83.62	508.11
29	.66	3.01	111.10	679.50
30	.73	3.60	135.97	840.35
31	.40	2.13	81.95	510.97
32	.38	2.12	82.70	518.85
33	.25	1.49	59.35	375.01
34	.23	1.44	58.06	369.10
35	.15	1.02	41.32	263.86
36	.15	1.09	44.67	286.64
37	.08	.57	23.69	152.54
38	.03	.20	8.18	52.81
39	.10	.85	35.38	229.22
40	.05	.45	18.83	122.37
41	.00	.00	.00	.00
42	.03	.24	10.12	65.96
43	.03	.26	10.92	71.45
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	49.68	68.52	2076.69	11244.53

TABLE 3.1.4: STAND TABLE BASED ON 1935 INVENTORY

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	4.79	.36	3.80	.00
5	5.31	.74	7.45	.00
6	6.07	1.21	12.54	.00
7	4.22	1.13	12.35	.00
8	2.96	1.04	12.43	.00
9	2.40	1.07	13.69	.00
10	2.02	1.10	15.28	.00
11	1.54	1.02	15.31	.00
12	1.74	1.37	22.84	67.81
13	.94	.86	15.58	51.83
14	1.04	1.12	22.57	80.96
15	1.11	1.37	28.88	108.90
16	.88	1.25	28.58	113.17
17	1.26	2.00	47.77	195.26
18	1.37	2.44	60.81	267.99
19	1.64	3.24	86.22	406.45
20	1.39	3.06	85.24	425.77
21	1.47	3.57	102.71	535.17
22	1.39	3.69	109.90	590.97
23	1.44	4.19	131.32	729.28
24	1.01	3.19	103.27	586.61
25	1.11	3.81	126.51	732.22
26	.96	3.57	123.40	728.66
27	.88	3.52	124.15	742.23
28	.66	2.81	103.03	626.06
29	.61	2.79	104.33	640.37
30	.76	3.74	140.14	864.53
31	.46	2.40	91.93	572.58
32	.30	1.69	66.08	415.02
33	.35	2.09	82.62	521.18
34	.20	1.29	52.01	330.81
35	.15	1.02	41.27	263.55
36	.18	1.27	52.04	333.96
37	.08	.57	23.45	150.91
38	.05	.39	16.27	104.97
39	.10	.85	35.68	231.23
40	.05	.45	18.98	123.39
41	.00	.00	.00	.00
42	.03	.24	10.22	66.65
43	.00	.00	.00	.00
44	.03	.26	11.13	72.82
45	.00	.00	.00	.00
TOTAL	51.96	71.77	2161.73	11681.30

TABLE 3.1.5:

STAND TABLE BASED ON 1940 INVENTORY

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	3.16	.30	3.14	.00
5	4.91	.69	7.02	.00
6	5.82	1.18	12.27	.00
7	5.23	1.42	15.63	.00
8	3.39	1.19	14.08	.00
9	2.91	1.30	16.74	.00
10	2.55	1.40	19.59	.00
11	1.74	1.17	17.57	.00
12	1.62	1.29	21.66	64.34
13	1.47	1.36	24.45	81.29
14	1.01	1.10	22.10	79.53
15	1.01	1.25	26.50	100.01
16	.94	1.30	29.34	115.53
17	1.19	1.89	45.04	184.28
18	1.19	2.11	53.20	234.18
19	1.49	2.94	77.56	364.77
20	1.59	3.48	96.56	480.66
21	1.44	3.49	99.81	518.60
22	1.54	4.10	122.75	661.03
23	1.42	4.11	127.36	705.28
24	1.31	4.16	135.20	769.01
25	.88	3.05	102.42	594.85
26	.96	3.57	122.21	720.02
27	.99	3.93	138.38	826.89
28	.76	3.26	119.52	726.46
29	.43	1.98	73.79	452.77
30	.73	3.63	136.70	844.87
31	.56	2.93	111.47	693.04
32	.35	1.97	76.83	481.66
33	.35	2.12	84.28	533.09
34	.10	.64	25.78	163.88
35	.20	1.35	54.68	349.01
36	.13	.90	36.73	235.52
37	.13	.94	38.81	245.68
38	.08	.59	24.51	158.11
39	.10	.86	35.87	232.58
40	.03	.23	9.52	61.87
41	.03	.23	9.62	62.55
42	.03	.24	10.32	67.33
43	.00	.00	.00	.00
44	.03	.27	11.28	73.85
45	.00	.00	.00	.00
TOTAL	54.78	73.89	2210.25	11886.73

TABLE 3.1.6:

STAND TABLE BASED ON 1945 INVENTORY

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	5.26	.47	5.08	.00
5	4.58	.64	6.51	.00
6	5.16	1.04	10.83	.00
7	6.04	1.65	18.23	.00
8	4.27	1.50	17.75	.00
9	3.26	1.46	18.80	.00
10	2.50	1.38	19.23	.00
11	2.12	1.40	20.93	.00
12	1.92	1.51	24.99	74.10
13	1.54	1.43	25.95	86.26
14	1.47	1.58	31.27	112.17
15	.91	1.13	24.11	91.29
16	1.14	1.60	36.13	142.34
17	.99	1.57	37.69	154.68
18	1.09	1.93	48.36	212.40
19	1.44	2.84	75.09	353.44
20	1.62	3.54	98.61	491.47
21	1.49	3.61	102.85	533.85
22	1.52	4.04	121.19	653.30
23	1.37	3.96	121.88	673.77
24	1.26	3.96	127.22	720.51
25	1.04	3.53	117.88	682.68
26	1.04	3.84	130.47	766.90
27	1.09	4.36	152.75	912.34
28	.81	3.48	127.15	772.30
29	.53	2.44	90.80	556.61
30	.61	3.01	113.83	704.02
31	.58	3.05	116.45	724.59
32	.43	2.40	93.13	583.57
33	.35	2.11	83.50	527.15
34	.15	.96	38.47	244.44
35	.23	1.53	62.05	396.26
36	.10	.72	29.78	191.10
37	.13	.95	39.14	251.95
38	.05	.40	16.42	105.95
39	.03	.21	8.92	57.81
40	.08	.66	27.80	180.51
41	.03	.23	9.77	63.57
42	.03	.24	10.32	67.33
43	.00	.00	.00	.00
44	.03	.27	11.43	74.88
45	.00	.00	.00	.00
TOTAL	58.26	76.64	2272.74	12163.56

TABLE 3.1.7:

STAND TABLE BASED ON 1950 INVENTORY

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	10.82	.98	10.50	.00
5	5.97	.82	8.26	.00
6	4.85	.97	10.07	.00
7	5.49	1.50	16.50	.00
8	5.51	1.92	22.67	.00
9	3.41	1.52	19.56	.00
10	3.11	1.71	23.78	.00
11	2.20	1.48	22.30	.00
12	2.12	1.68	27.88	83.23
13	1.59	1.49	27.13	90.92
14	1.54	1.66	32.78	117.49
15	1.06	1.31	27.76	104.72
16	1.09	1.52	34.63	136.72
17	1.09	1.73	41.40	169.58
18	.94	1.65	41.24	180.44
19	1.47	2.90	76.82	362.37
20	1.59	3.51	97.50	487.14
21	1.31	3.19	91.11	473.40
22	1.49	3.96	117.98	634.59
23	1.49	4.33	133.29	736.95
24	1.29	4.04	128.99	729.40
25	1.09	3.71	123.55	715.10
26	.94	3.45	118.14	695.37
27	1.06	4.24	147.95	882.15
28	.88	3.81	137.84	835.26
29	.48	2.21	82.18	503.66
30	.66	3.26	123.32	762.78
31	.53	2.79	107.22	667.99
32	.43	2.40	93.27	584.50
33	.33	1.95	76.43	481.31
34	.20	1.27	50.89	323.19
35	.18	1.19	48.23	308.00
36	.10	.72	29.50	189.18
37	.13	.95	39.05	251.31
38	.08	.59	24.55	158.44
39	.03	.21	8.92	57.81
40	.08	.66	27.75	180.18
41	.03	.23	9.77	63.57
42	.03	.25	10.37	67.68
43	.00	.00	.00	.00
44	.03	.27	11.43	74.88
45	.00	.00	.00	.00
TOTAL	66.70	78.03	2282.48	12109.25

TABLE 3.1.8:

STAND TABLE BASED ON 1955 INVENTORY

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	14.16	1.32	14.02	.00
5	11.35	1.55	15.69	.00
6	5.82	1.13	11.70	.00
7	5.03	1.38	15.21	.00
8	6.27	2.22	26.39	.00
9	3.84	1.69	21.77	.00
10	3.31	1.82	25.37	.00
11	2.38	1.56	23.31	.00
12	2.60	2.06	34.24	102.83
13	1.57	1.44	25.85	85.95
14	1.82	1.97	38.77	138.97
15	1.37	1.68	35.34	133.06
16	1.24	1.74	39.14	153.52
17	.88	1.41	33.92	139.59
18	1.11	1.97	49.15	215.20
19	1.39	2.76	72.88	344.19
20	1.42	3.12	86.42	431.53
21	1.39	3.34	95.61	495.47
22	1.49	3.96	117.47	631.17
23	1.59	4.62	142.32	786.83
24	1.39	4.40	140.43	795.45
25	.99	3.36	111.15	642.24
26	1.06	3.90	133.03	781.81
27	.99	3.93	136.68	814.08
28	.83	3.57	128.66	778.25
29	.58	2.67	98.71	604.27
30	.61	3.01	113.62	702.60
31	.53	2.78	106.65	664.14
32	.46	2.54	98.38	615.80
33	.28	1.65	64.87	409.04
34	.25	1.58	62.88	398.36
35	.18	1.19	48.50	309.87
36	.10	.72	29.54	189.50
37	.10	.75	31.01	199.48
38	.10	.79	33.03	213.23
39	.00	.00	.00	.00
40	.08	.67	27.95	181.53
41	.03	.23	9.77	63.57
42	.00	.00	.00	.00
43	.03	.25	10.57	69.05
44	.00	.00	.00	.00
45	.03	.27	11.58	75.91
TOTAL	78.63	81.02	2321.58	12166.48

TABLE 3.1.9:

STAND TABLE BASED ON 1960 INVENTORY

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	3.69	.37	3.85	.00
5	15.93	2.20	22.25	.00
6	11.10	2.19	22.60	.00
7	4.83	1.29	14.13	.00
8	6.25	2.20	26.21	.00
9	5.18	2.31	29.67	.00
10	3.36	1.85	25.70	.00
11	3.26	2.17	32.64	.00
12	2.20	1.75	29.80	88.18
13	2.10	1.94	35.72	117.86
14	1.57	1.69	33.46	119.79
15	1.67	2.04	42.97	161.56
16	1.42	1.98	44.35	173.58
17	1.04	1.63	39.24	160.77
18	1.19	2.12	53.38	235.65
19	1.21	2.42	64.25	304.67
20	1.31	2.89	80.18	400.03
21	1.52	3.66	105.65	549.20
22	1.47	3.90	115.96	623.69
23	1.52	4.41	136.88	758.43
24	1.39	4.40	140.35	794.96
25	1.21	4.14	136.37	787.23
26	1.16	4.31	149.30	881.68
27	.83	3.34	118.02	706.32
28	.94	4.01	145.00	878.27
29	.51	2.32	84.96	518.67
30	.53	2.61	99.19	613.96
31	.66	3.43	132.09	823.31
32	.40	2.26	88.20	553.39
33	.35	2.10	82.87	522.85
34	.25	1.59	63.18	400.37
35	.18	1.20	48.64	310.81
36	.13	.90	36.97	237.12
37	.10	.76	31.34	201.76
38	.10	.80	33.37	215.55
39	.00	.00	.00	.00
40	.08	.67	28.00	181.87
41	.00	.00	.00	.00
42	.00	.00	.00	.00
43	.03	.25	10.62	69.39
44	.00	.00	.00	.00
45	.03	.27	11.58	75.91
TOTAL	8 .68	84.37	2398.91	12466.80

TABLE 3.1.10:

STAND TABLE BASED ON 1970 INVENTORY

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	.00	.00	.00	.00
5	.03	.00	.03	.00
6	12.87	2.72	28.41	.00
7	14.89	4.00	43.95	.00
8	8.65	3.03	35.99	.00
9	6.17	2.74	35.23	.00
10	4.65	2.56	35.60	.00
11	3.69	2.44	36.65	.00
12	3.03	2.41	39.90	119.79
13	2.17	2.02	37.26	123.64
14	2.07	2.23	44.43	158.96
15	1.62	2.00	42.45	160.28
16	1.52	2.13	47.78	187.17
17	1.47	2.30	54.49	221.34
18	.94	1.66	41.81	183.71
19	1.34	2.64	69.07	324.66
20	1.19	2.60	71.52	355.69
21	1.42	3.40	97.77	507.10
22	1.42	3.75	112.25	603.90
23	1.39	4.04	124.26	687.08
24	1.52	4.78	152.79	865.25
25	1.26	4.34	142.37	821.77
26	1.21	4.47	152.18	894.39
27	.96	3.83	134.93	806.46
28	.94	4.03	145.64	881.93
29	.51	2.33	86.18	527.64
30	.48	2.36	88.21	543.71
31	.66	3.44	133.13	830.91
32	.40	2.26	88.27	553.94
33	.30	1.81	71.62	452.04
34	.28	1.76	70.97	451.18
35	.15	1.02	40.71	258.90
36	.15	1.07	43.10	275.08
37	.13	.95	39.43	253.91
38	.05	.41	17.05	110.26
39	.03	.21	8.92	57.81
40	.05	.45	18.98	123.39
41	.03	.23	9.67	62.89
42	.00	.00	.00	.00
43	.03	.25	10.57	69.05
44	.00	.00	.00	.00
45	.03	.28	11.68	76.59
TOTAL	79.67	88.99	2465.20	12550.41

3.2: Mortality Tables

TABLE 3.2.1:

MORTALITY BETWEEN 1920 AND 1925 INVENTORIES

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	.00	.00	.00	.00
5	.00	.00	.00	.00
6	.00	.00	.00	.00
7	.00	.00	.00	.00
8	.00	.00	.00	.00
9	.00	.00	.00	.00
10	.00	.00	.00	.00
11	.00	.00	.00	.00
12	.00	.00	.00	.00
13	.00	.00	.00	.00
14	.00	.00	.00	.00
15	.00	.00	.00	.00
16	.00	.00	.00	.00
17	.00	.00	.00	.00
18	.00	.00	.00	.00
19	.00	.00	.00	.00
20	.00	.00	.00	.00
21	.00	.00	.00	.00
22	.00	.00	.00	.00
23	.00	.00	.00	.00
24	.00	.00	.00	.00
25	.00	.00	.00	.00
26	.00	.00	.00	.00
27	.00	.00	.00	.00
28	.00	.00	.00	.00
29	.00	.00	.00	.00
30	.00	.00	.00	.00
31	.00	.00	.00	.00
32	.00	.00	.00	.00
33	.00	.00	.00	.00
34	.00	.00	.00	.00
35	.00	.00	.00	.00
36	.00	.00	.00	.00
37	.00	.00	.00	.00
38	.00	.00	.00	.00
39	.00	.00	.00	.00
40	.00	.00	.00	.00
41	.00	.00	.00	.00
42	.00	.00	.00	.00
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	.00	.00	.00	.00

TABLE 3.2.2:

MORTALITY BETWEEN 1925 AND 1930 INVENTORIES

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	.00	.00	.00	.00
5	.00	.00	.00	.00
6	.05	.01	.10	.00
7	.00	.00	.00	.00
8	.00	.00	.00	.00
9	.03	.01	.16	.00
10	.00	.00	.00	.00
11	.03	.02	.28	.00
12	.00	.00	.00	.00
13	.00	.00	.00	.00
14	.00	.00	.00	.00
15	.00	.00	.00	.00
16	.03	.03	.85	3.46
17	.00	.00	.00	.00
18	.00	.00	.00	.00
19	.00	.00	.00	.00
20	.05	.11	3.02	14.93
21	.03	.06	1.76	9.08
22	.00	.00	.00	.00
23	.00	.00	.00	.00
24	.05	.16	5.20	29.58
25	.00	.00	.00	.00
26	.00	.00	.00	.00
27	.00	.00	.00	.00
28	.00	.00	.00	.00
29	.05	.23	8.79	54.07
30	.03	.12	4.77	29.54
31	.03	.13	5.04	31.44
32	.00	.00	.00	.00
33	.00	.00	.00	.00
34	.00	.00	.00	.00
35	.00	.00	.00	.00
36	.00	.00	.00	.00
37	.03	.19	7.94	51.17
38	.00	.00	.00	.00
39	.00	.00	.00	.00
40	.00	.00	.00	.00
41	.00	.00	.00	.00
42	.00	.00	.00	.00
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	.38	1.08	37.92	223.29

TABLE 3.2.3:

MORTALITY BETWEEN 1935 AND 1940 INVENTORIES

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	.03	.00	.03	.00
5	.05	.01	.07	.00
6	.05	.01	.11	.00
7	.03	.01	.07	.00
8	.00	.00	.00	.00
9	.00	.00	.00	.00
10	.00	.00	.00	.00
11	.00	.00	.00	.00
12	.05	.04	.74	2.16
13	.08	.07	1.31	4.35
14	.00	.00	.00	.00
15	.03	.03	.72	2.78
16	.03	.04	.95	3.96
17	.00	.00	.00	.00
18	.00	.00	.00	.00
19	.00	.00	.00	.00
20	.00	.00	.00	.00
21	.00	.00	.00	.00
22	.00	.00	.00	.00
23	.03	.08	2.28	12.60
24	.03	.08	2.81	16.21
25	.05	.17	5.58	32.09
26	.05	.19	6.62	39.31
27	.00	.00	.00	.00
28	.03	.11	3.83	23.15
29	.03	.12	4.53	27.95
30	.00	.00	.00	.00
31	.00	.00	.00	.00
32	.03	.14	5.42	33.96
33	.03	.15	5.88	37.15
34	.00	.00	.00	.00
35	.00	.00	.00	.00
36	.00	.00	.00	.00
37	.00	.00	.00	.00
38	.00	.00	.00	.00
39	.00	.00	.00	.00
40	.00	.00	.00	.00
41	.00	.00	.00	.00
42	.00	.00	.00	.00
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	.58	1.24	40.93	235.67

TABLE 3.2.4:

MORTALITY BETWEEN 1930 AND 1935 INVENTORIES

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	.00	.00	.00	.00
5	.03	.00	.03	.00
6	.03	.01	.06	.00
7	.03	.01	.07	.00
8	.03	.01	.12	.00
9	.05	.02	.29	.00
10	.00	.00	.00	.00
11	.00	.00	.00	.00
12	.00	.00	.00	.00
13	.00	.00	.00	.00
14	.00	.00	.00	.00
15	.00	.00	.00	.00
16	.00	.00	.00	.00
17	.00	.00	.00	.00
18	.05	.09	2.42	10.94
19	.00	.00	.00	.00
20	.00	.00	.00	.00
21	.00	.00	.00	.00
22	.03	.06	1.83	9.67
23	.00	.00	.00	.00
24	.03	.08	2.66	15.19
25	.00	.00	.00	.00
26	.00	.00	.00	.00
27	.03	.10	3.79	22.91
28	.00	.00	.00	.00
29	.00	.00	.00	.00
30	.03	.13	4.92	30.62
31	.00	.00	.00	.00
32	.00	.00	.00	.00
33	.03	.15	6.10	38.63
34	.00	.00	.00	.00
35	.00	.00	.00	.00
36	.00	.00	.00	.00
37	.00	.00	.00	.00
38	.00	.00	.00	.00
39	.00	.00	.00	.00
40	.00	.00	.00	.00
41	.00	.00	.00	.00
42	.00	.00	.00	.00
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	.33	.67	22.31	127.96

TABLE 3.2.5:

MORTALITY BETWEEN 1940 AND 1945 INVENTORIES

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	.03	.00	.03	.00
5	.05	.01	.06	.00
6	.00	.00	.00	.00
7	.00	.00	.00	.00
8	.00	.00	.00	.00
9	.00	.00	.00	.00
10	.00	.00	.00	.00
11	.00	.00	.00	.00
12	.00	.00	.00	.00
13	.00	.00	.00	.00
14	.00	.00	.00	.00
15	.00	.00	.00	.00
16	.00	.00	.00	.00
17	.00	.00	.00	.00
18	.00	.00	.00	.00
19	.00	.00	.00	.00
20	.00	.00	.00	.00
21	.00	.00	.00	.00
22	.03	.06	2.03	10.90
23	.00	.00	.00	.00
24	.03	.08	2.75	15.80
25	.05	.17	5.79	33.66
26	.00	.00	.00	.00
27	.00	.00	.00	.00
28	.00	.00	.00	.00
29	.00	.00	.00	.00
30	.00	.00	.00	.00
31	.00	.00	.00	.00
32	.00	.00	.00	.00
33	.00	.00	.00	.00
34	.00	.00	.00	.00
35	.00	.00	.00	.00
36	.03	.18	7.52	48.25
37	.00	.00	.00	.00
38	.03	.20	8.23	53.14
39	.03	.22	9.02	58.48
40	.00	.00	.00	.00
41	.00	.00	.00	.00
42	.00	.00	.00	.00
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	.25	.92	35.42	220.23

TABLE 3.2.6:

MORTALITY BETWEEN 1945 AND 1950 INVENTORIES

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	.00	.00	.00	.00
5	.05	.01	.06	.00
6	.15	.03	.30	.00
7	.28	.07	.79	.00
8	.03	.01	.09	.00
9	.03	.01	.14	.00
10	.08	.04	.60	.00
11	.03	.02	.25	.00
12	.05	.04	.65	1.96
13	.03	.02	.40	1.30
14	.03	.03	.52	1.86
15	.03	.03	.71	2.69
16	.00	.00	.00	.00
17	.00	.00	.00	.00
18	.00	.00	.00	.00
19	.03	.05	1.39	6.54
20	.03	.05	1.60	7.99
21	.10	.24	6.80	35.10
22	.00	.00	.00	.00
23	.03	.07	2.32	12.87
24	.05	.16	5.37	30.78
25	.00	.00	.00	.00
26	.05	.19	6.73	39.99
27	.05	.21	7.48	45.11
28	.03	.11	4.12	25.13
29	.03	.11	4.23	25.88
30	.00	.00	.00	.00
31	.03	.13	5.09	31.72
32	.00	.00	.00	.00
33	.00	.00	.00	.00
34	.00	.00	.00	.00
35	.05	.33	13.59	86.70
36	.00	.00	.00	.00
37	.00	.00	.00	.00
38	.00	.00	.00	.00
39	.00	.00	.00	.00
40	.00	.00	.00	.00
41	.00	.00	.00	.00
42	.00	.00	.00	.00
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	1.21	1.97	63.21	355.63

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MORTALITY BETWEEN 1950 AND 1955 INVENTORIES

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	.00	.00	.00	.00
5	.03	.00	.04	.00
6	.03	.01	.06	.00
7	.00	.00	.00	.00
8	.00	.00	.00	.00
9	.00	.00	.00	.00
10	.03	.01	.18	.00
11	.00	.00	.00	.00
12	.03	.02	.30	.86
13	.00	.00	.00	.00
14	.00	.00	.00	.00
15	.00	.00	.00	.00
16	.03	.03	.85	3.46
17	.00	.00	.00	.00
18	.00	.00	.00	.00
19	.00	.00	.00	.00
20	.00	.00	.00	.00
21	.03	.06	1.95	10.39
22	.00	.00	.00	.00
23	.03	.07	2.34	13.06
24	.00	.00	.00	.00
25	.00	.00	.00	.00
26	.00	.00	.00	.00
27	.05	.20	7.41	44.63
28	.03	.11	4.15	25.38
29	.08	.34	12.76	78.16
30	.00	.00	.00	.00
31	.03	.14	5.33	33.40
32	.03	.14	5.54	34.82
33	.00	.00	.00	.00
34	.03	.16	6.28	39.83
35	.00	.00	.00	.00
36	.00	.00	.00	.00
37	.03	.19	7.90	50.85
38	.00	.00	.00	.00
39	.03	.21	8.92	57.81
40	.00	.00	.00	.00
41	.00	.00	.00	.00
42	.00	.00	.00	.00
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	.46	1.71	64.01	392.64

TABLE 3.2.8:

MORTALITY BETWEEN 1955 AND 1960 INVENTORIES

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	.00	.00	.00	.00
5	.00	.00	.00	.00
6	.00	.00	.00	.00
7	.00	.00	.00	.00
8	.08	.03	.31	.00
9	.00	.00	.00	.00
10	.00	.00	.00	.00
11	.00	.00	.00	.00
12	.00	.00	.00	.00
13	.00	.00	.00	.00
14	.00	.00	.00	.00
15	.00	.00	.00	.00
16	.00	.00	.00	.00
17	.03	.04	1.08	4.66
18	.00	.00	.00	.00
19	.00	.00	.00	.00
20	.00	.00	.00	.00
21	.00	.00	.00	.00
22	.00	.00	.00	.00
23	.03	.08	2.51	14.20
24	.03	.08	2.63	14.99
25	.00	.00	.00	.00
26	.00	.00	.00	.00
27	.03	.10	3.65	21.96
28	.00	.00	.00	.00
29	.03	.11	4.19	25.63
30	.03	.12	4.65	28.74
31	.00	.00	.00	.00
32	.03	.14	5.67	35.69
33	.00	.00	.00	.00
34	.00	.00	.00	.00
35	.00	.00	.00	.00
36	.00	.00	.00	.00
37	.00	.00	.00	.00
38	.00	.00	.00	.00
39	.00	.00	.00	.00
40	.00	.00	.00	.00
41	.03	.23	9.77	63.57
42	.00	.00	.00	.00
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	.28	.93	34.46	209.44

TABLE 3.2.9:

MORTALITY BETWEEN 1960 AND 1970 INVENTORIES

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	.00	.00	.00	.00
5	.00	.00	.00	.00
6	.00	.00	.00	.00
7	.00	.00	.00	.00
8	.08	.03	.31	.00
9	.00	.00	.00	.00
10	.00	.00	.00	.00
11	.03	.02	.25	.00
12	.00	.00	.00	.00
13	.00	.00	.00	.00
14	.08	.08	1.68	6.03
15	.03	.03	.63	2.34
16	.00	.00	.00	.00
17	.00	.00	.00	.00
18	.00	.00	.00	.00
19	.05	.10	2.81	13.37
20	.00	.00	.00	.00
21	.03	.06	1.98	10.56
22	.03	.07	2.23	12.32
23	.10	.29	9.33	51.94
24	.03	.08	2.54	14.40
25	.05	.17	5.50	31.57
26	.03	.09	2.98	17.23
27	.16	.60	21.74	130.59
28	.05	.22	7.90	48.02
29	.00	.00	.00	.00
30	.08	.37	14.06	87.02
31	.03	.13	5.04	31.44
32	.08	.42	16.50	103.61
33	.03	.15	5.88	37.15
34	.00	.00	.00	.00
35	.03	.17	7.00	44.76
36	.00	.00	.00	.00
37	.03	.19	7.70	49.55
38	.03	.20	8.38	54.13
39	.00	.00	.00	.00
40	.00	.00	.00	.00
41	.00	.00	.00	.00
42	.00	.00	.00	.00
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	.99	3.47	124.46	746.03

3.3: Net Periodic Growth Tables

TABLE 3.3.1:
NET PERIODIC GROWTH FOR THE PERIOD 1920 TO 1925

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	1.34	.12	1.26	.00
5	.15	.03	.31	.00
6	1.04	.20	2.08	.00
7	.68	.19	2.08	.00
8	-.05	-.01	-.04	.00
9	.58	.27	3.45	.00
10	.43	.23	3.13	.00
11	-.08	-.05	-.72	.00
12	.15	.11	1.83	5.31
13	-.13	-.12	-2.35	-7.63
14	.05	.04	.72	2.24
15	-.18	-.20	-3.85	-13.64
16	-.05	-.08	-2.10	-9.17
17	.03	.06	1.83	8.78
18	.10	.18	4.51	19.80
19	-.10	-.19	-5.01	-22.94
20	-.23	-.53	-15.11	-77.42
21	.48	1.16	33.07	171.61
22	-.13	-.34	-10.86	-59.31
23	.18	.51	15.83	87.49
24	.10	.33	10.38	58.89
25	-.18	-.60	-20.83	-121.68
26	.25	.93	31.72	186.52
27	.03	.11	5.09	32.37
28	-.13	-.56	-21.29	-131.03
29	.18	.82	30.23	185.14
30	.03	.13	4.58	27.85
31	.05	.27	10.46	65.41
32	-.03	-.12	-4.58	-28.29
33	.03	.15	5.97	37.74
34	.00	.00	.09	.62
35	.03	.17	6.73	42.88
36	.00	.00	.09	.64
37	.03	.19	7.80	50.21
38	-.05	-.41	-17.05	-110.26
39	.03	.20	8.43	54.45
40	.03	.22	9.17	59.49
41	.00	.00	.10	.68
42	-.03	-.25	-10.47	-68.36
43	.03	.25	10.67	69.73
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	4.65	3.43	97.34	518.12

TABLE 3.3.2:
NET PERIODIC GROWTH FOR THE PERIOD 1925 TO 1930

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	-.46	-.04	-.42	.00
5	1.14	.15	1.49	.00
6	.68	.15	1.54	.00
7	.61	.15	1.66	.00
8	.76	.27	3.29	.00
9	.00	.00	.05	.00
10	.43	.24	3.47	.00
11	.78	.52	7.72	.00
12	.13	.10	1.72	5.48
13	-.08	-.07	-1.28	-4.18
14	.08	.09	1.77	6.54
15	-.28	-.35	-7.69	-29.46
16	.00	-.01	-.34	-1.61
17	-.25	-.40	-9.35	-37.61
18	.18	.32	7.52	33.37
19	.08	.14	3.71	16.77
20	.08	.17	5.14	26.33
21	-.25	-.59	-16.35	-83.28
22	.18	.43	10.62	53.14
23	.18	.52	16.12	89.54
24	-.10	-.31	-10.23	-58.05
25	.15	.50	15.67	88.89
26	-.03	-.08	-3.54	-21.73
27	.15	.59	20.91	124.78
28	-.03	-.12	-3.86	-22.76
29	-.18	-.83	-31.11	-191.52
30	.23	1.11	41.39	254.91
31	-.08	-.40	-16.16	-101.80
32	.03	.12	4.56	28.16
33	.03	.14	5.58	35.07
34	.03	.15	6.14	38.91
35	.05	.34	14.00	89.51
36	.03	.19	7.70	49.83
37	-.05	-.38	-15.79	-101.70
38	.03	.20	8.18	52.81
39	.00	.01	.44	3.01
40	.00	.00	.15	1.02
41	-.03	-.24	-9.97	-64.94
42	.03	.24	10.12	65.96
43	.00	.01	.25	1.72
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	4.22	3.05	74.82	346.81

TABLE 3.3.3:
NET PERIODIC GROWTH FOR THE PERIOD 1930 TO 1935

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	-1.44	-.11	-1.27	.00
5	-.68	-.09	-.89	.00
6	1.19	.24	2.44	.00
7	.99	.26	2.90	.00
8	.18	.05	.58	.00
9	.48	.20	2.55	.00
10	.46	.23	3.17	.00
11	-.05	-.04	-.74	.00
12	.76	.59	9.84	28.96
13	.13	.11	1.86	6.08
14	-.13	-.13	-2.47	-8.58
15	.20	.24	4.71	17.18
16	-.28	-.39	-8.54	-33.11
17	-.08	-.14	-3.61	-16.30
18	-.18	-.32	-8.41	-37.32
19	.28	.56	14.79	70.11
20	.00	.02	.98	6.47
21	.03	.08	2.25	12.58
22	.10	.30	9.07	50.10
23	.03	.10	2.84	16.48
24	.03	.08	2.13	11.51
25	.08	.27	8.73	50.34
26	-.03	-.08	-2.64	-15.12
27	.03	.08	1.46	6.11
28	.13	.52	19.41	117.95
29	-.05	-.22	-6.76	-39.14
30	.03	.14	4.17	24.18
31	.05	.27	9.98	61.61
32	-.08	-.43	-16.62	-103.83
33	.10	.60	23.27	146.17
34	-.03	-.15	-6.05	-38.30
35	.00	-.00	-.05	-.31
36	.03	.18	7.38	47.31
37	.00	-.01	-.24	-1.63
38	.03	.19	8.09	52.15
39	.00	.01	.30	2.01
40	.00	.00	.15	1.02
41	.00	.00	.00	.00
42	.00	.00	.10	.69
43	-.03	-.26	-10.92	-71.45
44	.03	.26	11.13	72.82
45	.00	.00	.00	.00
TOTAL	2.28	3.25	85.05	436.77

TABLE 3.3.4:
NET PERIODIC GROWTH FOR THE PERIOD 1935 TO 1940

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	-.63	-.06	-.65	.00
5	-.40	-.04	-.43	.00
6	-.25	-.03	-.27	.00
7	1.01	.29	3.28	.00
8	.43	.14	1.65	.00
9	.51	.23	3.04	.00
10	.53	.30	4.30	.00
11	.20	.15	2.26	.00
12	-.13	-.09	-1.18	-3.47
13	.53	.49	8.87	29.47
14	-.03	-.02	-.47	-1.43
15	-.10	-.12	-2.38	-8.89
16	.05	.05	.76	2.36
17	-.08	-.11	-2.73	-10.98
18	-.18	-.32	-7.61	-33.81
19	-.15	-.31	-8.66	-41.68
20	.20	.42	11.31	54.88
21	-.03	-.07	-2.90	-16.57
22	.15	.40	12.86	70.06
23	-.03	-.08	-3.96	-24.00
24	.30	.98	31.93	182.41
25	-.23	-.76	-24.09	-137.37
26	.00	.00	-1.18	-8.64
27	.10	.42	14.23	84.66
28	.10	.45	16.49	100.40
29	-.18	-.82	-30.54	-187.60
30	-.03	-.11	-3.44	-19.66
31	.10	.53	19.55	120.46
32	.05	.29	10.76	66.84
33	.00	.02	1.66	11.92
34	-.10	-.65	-26.23	-166.93
35	.05	.33	13.41	85.46
36	-.05	-.37	-15.31	-98.43
37	.05	.37	15.36	98.76
38	.03	.20	8.23	53.14
39	.00	.00	.20	1.35
40	-.03	-.23	-9.47	-61.53
41	.03	.23	9.62	62.55
42	.00	.00	.10	.69
43	.00	.00	.00	.00
44	.00	.00	.15	1.03
45	.00	.00	.00	.00
TOTAL	1.82	2.12	48.52	205.43

TABLE 3.3.5:

NET PERIODIC GROWTH FOR THE PERIOD 1940 TO 1945

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	2.10	.18	1.94	.00
5	-.33	-.05	-.50	.00
6	-.66	-.14	-1.43	.00
7	.81	.23	2.60	.00
8	.88	.31	3.67	.00
9	.35	.16	2.07	.00
10	-.05	-.03	-.35	.00
11	.38	.23	3.36	.00
12	.30	.22	3.33	9.76
13	.08	.07	1.50	4.97
14	.46	.48	9.17	32.65
15	-.10	-.12	-2.39	-8.72
16	.20	.30	6.79	26.81
17	-.20	-.31	-7.35	-29.60
18	-.10	-.18	-4.84	-21.79
19	-.05	-.09	-2.47	-11.33
20	.03	.06	2.05	10.81
21	.05	.12	3.04	15.25
22	-.03	-.05	-1.57	-7.73
23	-.05	-.15	-5.48	-31.51
24	-.05	-.20	-7.98	-48.51
25	.15	.48	15.46	87.83
26	.08	.27	8.26	46.88
27	.10	.42	14.37	85.45
28	.05	.22	7.63	45.85
29	.10	.46	17.01	103.84
30	-.13	-.61	-22.87	-140.85
31	.03	.12	4.98	31.55
32	.08	.43	16.30	101.71
33	.00	-.01	-.78	-5.94
34	.05	.32	12.69	80.56
35	.03	.18	7.37	47.25
36	-.03	-.17	-6.95	-44.42
37	.00	.01	.33	2.28
38	-.03	-.19	-8.09	-52.15
39	-.08	-.64	-26.95	-174.77
40	.05	.44	18.28	118.65
41	.00	.00	.15	1.02
42	.00	.00	.00	.00
43	.00	.00	.00	.00
44	.00	.00	.15	1.03
45	.00	.00	.00	.00
TOTAL	4.48	2.75	62.48	276.83

TABLE 3.3.6:

NET PERIODIC GROWTH FOR THE PERIOD 1945 TO 1950

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	5.56	.51	5.42	.00
5	1.39	.17	1.75	.00
6	-.30	-.07	-.76	.00
7	-.56	-.16	-1.73	.00
8	1.24	.42	4.92	.00
9	.15	.06	.76	.00
10	.61	.33	4.54	.00
11	.08	.08	1.37	.00
12	.20	.17	2.89	9.12
13	.05	.06	1.18	4.65
14	.08	.08	1.51	5.31
15	.15	.18	3.65	13.43
16	-.05	-.07	-1.50	-5.63
17	.10	.16	3.71	14.90
18	-.15	-.28	-7.12	-31.96
19	.03	.06	1.73	8.93
20	-.03	-.03	-1.11	-4.33
21	-.18	-.43	-11.74	-60.45
22	-.03	-.08	-3.20	-18.71
23	.13	.37	11.41	63.18
24	.03	.08	1.77	8.89
25	.05	.19	5.67	32.42
26	-.10	-.39	-12.33	-71.53
27	-.03	-.11	-4.80	-30.20
28	.08	.33	10.69	62.95
29	-.05	-.23	-8.62	-52.95
30	.05	.25	9.49	58.76
31	-.05	-.25	-9.23	-56.60
32	.00	.00	.13	.93
33	-.03	-.16	-7.07	-45.84
34	.05	.31	12.42	78.75
35	-.05	-.34	-13.82	-88.26
36	.00	-.01	-.28	-1.92
37	.00	-.00	-.09	-.64
38	.03	.20	8.14	52.48
39	.00	.00	.00	.00
40	.00	-.00	-.05	-.34
41	.00	.00	.00	.00
42	.00	.00	.05	.34
43	.00	.00	.00	.00
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	8.45	1.39	9.74	-54.31

TABLE 3.3.7:

NET PERIODIC GROWTH FOR THE PERIOD 1950 TO 1955

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	3.34	.34	3.52	.00
5	5.39	.74	7.44	.00
6	.96	.16	1.63	.00
7	-.46	-.12	-1.29	.00
8	.76	.30	3.71	.00
9	.43	.18	2.21	.00
10	.20	.12	1.59	.00
11	.18	.08	1.00	.00
12	.48	.39	6.37	19.61
13	-.03	-.05	-1.28	-4.97
14	.28	.30	5.99	21.49
15	.30	.36	7.57	28.34
16	.15	.22	4.51	16.80
17	-.20	-.32	-7.48	-29.99
18	.18	.31	7.91	34.76
19	-.08	-.14	-3.94	-18.18
20	-.18	-.39	-11.08	-55.61
21	.08	.16	4.51	22.08
22	.00	-.00	-.51	-3.41
23	.10	.29	9.02	49.88
24	.10	.35	11.44	66.05
25	-.10	-.35	-12.40	-72.86
26	.13	.45	14.89	86.44
27	-.08	-.31	-11.26	-68.07
28	-.05	-.23	-9.18	-57.01
29	.10	.45	16.53	100.62
30	-.05	-.25	-9.70	-60.17
31	.00	-.01	-.57	-3.84
32	.03	.14	5.11	31.30
33	-.05	-.30	-11.56	-72.27
34	.05	.31	12.00	75.17
35	.00	.01	.28	1.87
36	.00	.00	.05	.31
37	-.03	-.19	-8.04	-51.83
38	.03	.20	8.48	54.79
39	-.03	-.21	-8.92	-57.81
40	.00	.00	.20	1.35
41	.00	.00	.00	.00
42	-.03	-.25	-10.37	-67.68
43	.03	.25	10.57	69.05
44	-.03	-.27	-11.43	-74.88
45	.03	.27	11.58	75.91
TOTAL	11.93	2.99	39.11	57.24

TABLE 3.3.8:

NET PERIODIC GROWTH FOR THE PERIOD 1955 TO 1960

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	-10.47	-.95	-10.17	.00
5	4.58	.65	6.55	.00
6	5.28	1.05	10.90	.00
7	-.20	-.09	-1.08	.00
8	-.03	-.01	-.18	.00
9	1.34	.61	7.90	.00
10	.05	.02	.33	.00
11	.88	.61	9.33	.00
12	-.40	-.31	-4.44	-14.65
13	.53	.50	9.87	31.91
14	-.25	-.28	-5.31	-19.18
15	.30	.37	7.63	28.50
16	.18	.24	5.21	20.06
17	.15	.23	5.32	21.17
18	.08	.16	4.23	20.46
19	-.18	-.33	-8.63	-39.52
20	-.10	-.23	-6.25	-31.50
21	.13	.32	10.03	53.73
22	-.03	-.06	-1.51	-7.49
23	-.08	-.21	-5.44	-28.40
24	.00	-.00	-.08	-.49
25	.23	.78	25.22	144.99
26	.10	.41	16.27	99.87
27	-.15	-.60	-18.66	-107.76
28	.10	.43	16.34	100.02
29	-.08	-.35	-13.75	-85.60
30	-.08	-.40	-14.43	-88.65
31	.13	.65	25.44	159.17
32	-.05	-.28	-10.19	-62.41
33	.08	.45	18.00	113.81
34	.00	.01	.30	2.01
35	.00	.00	.14	.94
36	.03	.18	7.42	47.62
37	.00	.01	.33	2.28
38	.00	.01	.34	2.32
39	.00	.00	.00	.00
40	.00	.00	.05	.34
41	-.03	-.23	-9.77	-63.57
42	.00	.00	.00	.00
43	.00	.00	.05	.34
44	.00	.00	.00	.00
45	.00	.00	.00	.00
TOTAL	2.05	3.36	77.33	300.31

TABLE 3.3.9:

NET PERIODIC GROWTH FOR THE PERIOD 1960 TO 1970

DIAMETER BREAST HEIGHT	TREES PER ACRE	BASAL AREA PER ACRE	VOLUMES PER ACRE	
INCHES	NUMBER	SQUARE FEET	CUBIC FEET	BOARD FEET
4	-3.69	-.37	-3.85	.00
5	-15.90	-2.20	-22.21	.00
6	1.77	.54	5.82	.00
7	10.06	2.71	29.82	.00
8	2.40	.83	9.78	.00
9	.99	.43	5.55	.00
10	1.29	.71	9.90	.00
11	.43	.27	4.01	.00
12	.83	.65	10.10	31.61
13	.08	.08	1.54	5.78
14	.51	.54	10.96	39.17
15	-.05	-.04	-.52	-1.28
16	.10	.15	3.43	13.60
17	.43	.67	15.24	60.58
18	-.25	-.46	-11.57	-51.94
19	.13	.22	4.82	20.00
20	-.13	-.28	-8.65	-44.34
21	-.10	-.26	-7.88	-42.10
22	-.05	-.15	-3.71	-19.79
23	-.13	-.37	-12.62	-71.35
24	.13	.39	12.45	70.29
25	.05	.20	6.00	34.53
26	.05	.16	2.88	12.70
27	.13	.49	16.90	100.14
28	.00	.03	.63	3.66
29	.00	.01	1.22	8.97
30	-.05	-.25	-10.98	-70.24
31	.00	.01	1.04	7.60
32	.00	.00	.07	.55
33	-.05	-.29	-11.25	-70.81
34	.03	.18	7.78	50.81
35	-.03	-.18	-7.93	-51.92
36	.03	.17	6.13	37.96
37	.03	.19	8.09	52.16
38	-.05	-.39	-16.32	-105.29
39	.03	.21	8.92	57.81
40	-.03	-.22	-9.02	-58.47
41	.03	.23	9.67	62.89
42	.00	.00	.00	.00
43	.00	-.00	-.05	-.34
44	.00	.00	.00	.00
45	.00	.00	.10	.68
TOTAL	-1.01	4.62	66.28	83.62

3.4: Summary Tables

TABLE 3.4.1:

AVERAGE ANNUAL DIAMETER GROWTH BY SIZE CLASSES

DIAMETER BREAST HEIGHT	GROWTH PERIOD								
	1920-25	1925-30	1930-35	1935-40	1940-45	1945-50	1950-55	1955-60	1960-70
INCHES	INCHES								
4	.68	.70	.57	.62	.73	.73	.75	.56	.00
5	.22	.28	.17	.15	.11	.12	.16	.15	.10
6	.14	.17	.16	.14	.12	.12	.12	.14	.14
7	.16	.19	.16	.13	.11	.10	.11	.12	.14
8	.15	.20	.17	.15	.12	.10	.11	.11	.13
9	.17	.20	.18	.16	.11	.10	.11	.11	.09
10	.15	.21	.16	.16	.11	.10	.13	.10	.09
11	.11	.20	.16	.14	.13	.10	.12	.12	.09
12	.11	.13	.14	.12	.10	.08	.12	.09	.08
13	.10	.11	.13	.13	.11	.09	.11	.11	.08
14	.08	.11	.09	.09	.10	.08	.11	.10	.08
15	.10	.09	.11	.08	.08	.07	.10	.10	.07
16	.11	.12	.08	.09	.08	.05	.07	.09	.07
17	.12	.10	.10	.07	.07	.06	.07	.07	.06
18	.10	.11	.10	.09	.08	.05	.08	.07	.06
19	.09	.11	.10	.08	.08	.05	.06	.06	.06
20	.09	.11	.10	.09	.07	.06	.06	.06	.05
21	.09	.09	.10	.08	.08	.06	.06	.07	.05
22	.10	.10	.09	.07	.07	.05	.06	.06	.05
23	.07	.08	.08	.05	.07	.05	.05	.06	.05
24	.08	.08	.08	.07	.07	.05	.06	.05	.06
25	.07	.10	.07	.06	.06	.04	.05	.06	.05
26	.07	.07	.07	.07	.06	.03	.05	.05	.05
27	.05	.07	.06	.06	.06	.03	.04	.03	.04
28	.06	.05	.05	.04	.07	.04	.04	.04	.03
29	.09	.07	.06	.04	.04	.03	.05	.05	.04
30	.06	.06	.06	.06	.04	.02	.03	.03	.05
31	.04	.06	.05	.06	.04	.02	.03	.03	.02
32	.05	.04	.05	.04	.05	.02	.03	.04	.04
33	.07	.05	.06	.04	.05	.02	.04	.05	.04
34	.06	.09	.06	-.01	.06	.03	.04	.03	.03
35	.06	.09	.05	.03	.04	.01	.05	.03	.03
36	.04	.05	.05	.03	.06	.02	.05	.04	.07
37	.03	.03	.04	.05	.03	.02	.04	.04	.03
38	.00	.06	.01	.04	.03	.03	.05	.03	.04
39	.04	.04	.03	.02	.00	.00	.00	.00	.09
40	.03	.03	.03	.00	.05	-.01	.03	.01	.02
41	.04	.00	.00	.06	.06	.00	.00	.00	.09
42	.00	.06	.04	.04	.00	.02	.00	.00	.00
43	.08	.10	.00	.00	.00	.00	.08	.02	-.01
44	.00	.00	.08	.06	.06	.00	.00	.00	.00
45	.20	.20	.20	.00	.00	.20	.06	.00	.02

[illegible]

PERCENT OF TREES IN A DIAMETER CLASS
ADVANCING TO THE NEXT DIAMETER CLASS
DURING THE GROWTH PERIOD

DIAMETER BREAST HEIGHT	GROWTH PERIOD 1920-25	1925-30	1930-35	1935-40	1940-45	1945-50	1950-55	1955-60	1960-70
INCHES					PERCENT				
4	79.11	80.19	66.00	73.60	89.90	89.02	86.96	60.96	.00
5	64.06	74.68	63.81	57.22	53.04	64.83	78.17	77.78	100.00
6	71.69	68.91	68.75	56.09	53.92	53.12	61.74	72.89	89.00
7	77.88	85.94	74.85	63.77	56.49	51.23	50.25	58.64	91.00
8	66.25	82.73	75.21	72.39	63.31	56.42	49.19	48.58	79.24
9	75.00	81.58	86.32	69.57	55.04	51.33	59.87	59.02	75.41
10	77.78	88.71	77.50	64.36	58.59	53.66	56.49	50.38	81.52
11	56.25	77.78	77.05	62.32	69.05	44.83	69.15	53.49	76.71
12	55.88	53.85	72.46	56.25	60.53	41.67	57.28	39.08	76.67
13	42.86	43.75	59.46	65.52	55.74	39.68	62.90	57.83	69.77
14	44.19	43.48	41.46	37.50	51.72	36.07	56.94	45.16	74.39
15	38.30	44.44	52.27	40.00	36.11	42.86	55.56	56.06	60.94
16	52.17	58.70	37.14	51.35	37.78	25.58	36.73	46.43	66.67
17	42.86	45.28	32.00	34.04	23.08	30.23	31.43	46.34	62.07
18	50.00	55.74	51.85	40.43	39.53	24.32	43.18	25.53	54.05
19	45.10	53.70	50.77	44.07	36.84	25.86	21.82	18.75	60.38
20	50.00	49.09	40.00	50.79	35.94	2 .63	26.79	30.77	51.06
21	50.75	36.84	39.66	42.11	37.29	25.00	40.00	31.67	51.79
22	36.36	58.82	40.00	40.98	33.33	27.12	30.51	25.86	55.36
23	44.90	39.29	29.82	32.14	37.04	27.12	28.57	26.67	52.73
24	32.56	41.03	40.00	36.54	42.00	21.57	23.64	30.91	55.00
25	28.57	46.34	31.82	17.14	53.66	18.60	23.08	33.33	52.00
26	42.50	33.33	28.95	34.21	34.15	16.22	30.95	15.22	50.00
27	25.00	41.18	34.29	28.21	25.58	19.05	20.51	9.09	55.26
28	27.27	38.10	38.46	20.00	25.00	20.00	27.27	21.62	27.03
29	36.36	34.62	20.83	5.88	28.57	15.79	43.48	20.00	40.00
30	25.00	48.28	23.33	24.14	8.33	11.54	12.50	28.57	42.11
31	21.05	25.00	27.78	36.36	30.43	4.76	23.81	30.77	23.08
32	14.29	40.00	25.00	28.57	35.29	11.76	22.22	18.75	37.50
33	33.33	50.00	42.86	7.14	21.43	15.38	18.18	28.57	25.00
34	25.00	44.44	12.50	.00	50.00	37.50	40.00	10.00	27.27
35	50.00	50.00	33.33	37.50	11.11	14.29	14.29	14.29	33.33
36	20.00	16.67	28.57	20.00	.00	25.00	25.00	20.00	50.00
37	20.00	.00	33.33	60.00	.00	2 .00	25.00	.00	40.00
38	.00	100.00	50.00	33.33	.00	33.33	25.00	.00	.00
39	50.00	.00	.00	.00	.00	.00	.00	.00	100.00
40	50.00	.00	.00	.00	66.67	.00	.00	.00	.00
41	.00	.00	.00	100.00	.00	.00	.00	.00	100.00
42	.00	100.00	.00	.00	.00	.00	.00	.00	.00
43	100.00	.00	.00	.00	.00	.00	100.00	.00	.00
44	.00	.00	100.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	5.26	.00	.00

TABLE [illegible]:

MORTALITY FOR THE PERIOD 1920 TO 1970
BY DIAMETER CLASS AND KILLING AGENT

DIAMETER BREAST HEIGHT	TOTAL MORTALITY	KILLING AGENT LIGHTNING	WIND	INSECTS	RUST	DWARF-MISTLETOE	SUPPRESSED	ROOT ROT	OTHER IDENTIFIED	UNIDENTIFIED
INCHES					PERCENT					
4	.14	.00	.00	.09	.00	.00	.05	.00	.00	.00
5	.32	.00	.00	.04	.00	.00	.16	.00	.04	.08
6	.44	.00	.08	.12	.00	.00	.20	.00	.00	.04
7	.61	.00	.00	.42	.00	.00	.09	.00	.00	.09
8	.46	.00	.06	.06	.00	.00	.11	.00	.00	.23
9	.31	.00	.08	.00	.00	.00	.16	.00	.00	.08
10	.41	.00	.00	.10	.00	.00	.00	.00	.00	.30
11	.37	.00	.00	.00	.00	.00	.00	.00	.12	.25
12	.71	.00	.14	.28	.00	.00	.00	.14	.00	.14
13	.72	.18	.00	.18	.00	.00	.18	.00	.00	.18
14	.73	.00	.00	.18	.00	.00	.18	.00	.18	.18
15	.62	.00	.21	.21	.00	.00	.00	.00	.21	.00
16	.65	.22	.43	.00	.00	.00	.00	.00	.00	.00
17	.20	.00	.00	.20	.00	.00	.00	.00	.00	.00
18	.42	.00	.00	.00	.00	.21	.00	.00	.21	.00
19	.54	.36	.00	.00	.00	.00	.18	.00	.00	.00
20	.53	.18	.00	.18	.00	.00	.00	.00	.00	.18
21	1.23	.18	.00	.18	.18	.00	.00	.00	.00	.70
22	.72	.18	.00	.36	.00	.00	.00	.00	.18	.00
23	1.27	.36	.18	.36	.36	.00	.00	.00	.00	.00
24	1.86	.21	.21	.62	.00	.21	.00	.00	.21	.41
25	1.44	.00	.00	1.20	.00	.00	.00	.00	.24	.00
26	1.25	.25	.25	.50	.25	.00	.00	.00	.00	.00
27	3.35	1.40	.00	1.12	.00	.00	.00	.00	.56	.28
28	1.67	.33	.33	.67	.33	.00	.00	.00	.00	.00
29	3.49	1.75	.87	.87	.00	.00	.00	.00	.00	.00
30	2.49	.83	.00	1.24	.41	.00	.00	.00	.00	.00
31	1.91	.48	.00	.96	.00	.48	.00	.00	.00	.00
32	3.90	1.30	.00	1.30	.65	.65	.00	.00	.00	.00
33	2.52	.00	.84	.84	.84	.00	.00	.00	.00	.00
34	1.22	1.22	.00	.00	.00	.00	.00	.00	.00	.00
35	4.76	.00	.00	1.59	.00	.00	.00	.00	1.59	1.59
36	1.96	1.96	.00	.00	.00	.00	.00	.00	.00	.00
37	6.98	.00	.00	6.98	.00	.00	.00	.00	.00	.00
38	8.70	4.35	.00	4.35	.00	.00	.00	.00	.00	.00
39	9.09	4.55	4.55	.00	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
41	14.29	.00	14.29	.00	.00	.00	.00	.00	.00	.00
42	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
WEIGHTED AVG	4.59	.95	.82	.65	.51	.40	.32	.28	.22	.21
PERCENTAGE	100.00	20.65	17.76	14.18	11.10	8.69	7.04	6.01	4.74	4.57

TABLE [illegible]:

```
                           STAND TABLE SUMMARY

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
               TREES        BASAL AREA              VOLUMES
INVENTORY    PER ACRE        PER ACRE               PER ACRE
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
  YEAR        NUMBER       SQUARE FEET      CUBIC FEET      BOARD FEET
  1920         40.81           62.04         1904.53        10379.60
  1925         45.46           65.47         2001.87        10897.73
  1930         49.68           68.52         2076.69        11244.53
  1935         51.96           71.77         2161.73        11681.30
  1940         53.78           73.89         2210.25        11886.73
  1945         58.26           76.64         2272.74        12163.56
  1950         66.70           78.03         2282.48        12109.25
  1955         78.63           81.02         2321.58        12166.48
  1960         82.68           84.37         2398.91        12466.80
  1970         79.67           88.99         2465.20        12550.41
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
TOT. CHANGE    38.86           26.95          560.67         2170.81
 1920-70
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

TABLE [illegible]:

```
                         MORTALITY TABLE SUMMARY

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
               TREES        BASAL AREA              VOLUMES
 PERIOD       PER ACRE       PER ACRE               PER ACRE
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 YEARS        NUMBER      SQUARE FEET      CUBIC FEET      BOARD FEET
 1920-25         .00             .00             .00             .00
 1925-30         .38            1.08           37.92          223.29
 1930-35         .33             .67           22.31          127.96
 1935-40         .58            1.24           40.93          235.67
 1940-45         .25             .92           35.42          220.23
 1945-50         .21            1.97           63.21          355.63
 1950-55         .46            1.71           64.01          392.64
 1955-60         .28             .93           34.46          209.44
 1960-70         .99            3.47          124.46          746.03
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
  TOTAL         4.48           12.00          422.71         2510.88
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

TABLE [illegible]:

```
                        NET GROWTH TABLE SUMMARY

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
               TREES        BASAL AREA              VOLUMES
 PERIOD       PER ACRE       PER ACRE               PER ACRE
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 YEARS        NUMBER      SQUARE FEET      CUBIC FEET      BOARD FEET
 1920-25        4.65            3.43           97.34          518.12
 1925-30        4.22            3.05           74.82          346.81
 1930-35        2.28            3.25           85.05          436.77
 1935-40        1.82            2.12           48.52          205.43
 1940-45        4.48            2.75           62.48          276.83
 1945-50        8.45            1.39            9.74          -54.31
 1950-55       11.93            2.99           39.11           57.24
 1955-60        4.05            3.36           77.33          300.31
 1960-70       -3.01            4.62           66.28           83.62
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
  TOTAL        38.86           26.95          560.67         2170.81
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
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Agriculture—CSU, Fort Collins

Avery, Charles C., Frederic R. Larson, and Gilbert H. Schubert.
1976. Fifty-year records of virgin stand development in southwestern ponderosa pine. USDA For. Serv. Gen. Tech. Rep. RM-22, 71 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo. 80521

Ten periodic inventories of an unburned virgin tract of southwestern ponderosa pine near Flagstaff, Arizona, have yielded growth and mortality data on more than 3,000 trees. Fifty years of change on this 40-acre tract are documented, principally in nonmetric units, by (1) individual tree records, (2) 2.5-acre (1.01-ha) subplot summaries of basal area and tree census (tree count) data, and (3) composite stand tables which display volumes (cubic feet and board feet), census data, mortality data and causes, net periodic basal area, volume, and diameter growth. This information should be useful in modeling stand development and also as a data source for research and teaching.

Keywords: *Pinus ponderosa*, stand structure, natural areas.

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User's Guide to SWYLD2: Yield Tables for Even-Aged and Two-Storied Stands of Southwestern Ponderosa Pine, Including Effects of Dwarf Mistletoe

March 1976

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USDA Forest Service
General Technical Report RM-23
Rocky Mountain Forest and
Range Experiment Station
Forest Service
U.S. Department of Agriculture
Fort Collins, Colorado 80521

Abstract

Edminster, Carleton B., and Frank G. Hawksworth.
1976. User's guide to SWYLD2: Yield tables for even-aged and two-storied stands of southwestern ponderosa pine, including effects of dwarf mistletoe. USDA For. Serv. Gen. Tech. Rep. RM-23, 8 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Describes procedures for application of computer program SWYLD2 (Myers and others 1976) for yield simulation of even-aged and two-storied stands of southwestern ponderosa pine, including the effects of dwarf mistletoe. SWYLD2 supersedes SWYLD program, published in USDA For. Serv. Res. Pap. RM-87, 1972.

Keywords: *Pinus ponderosa*, *Arceuthobium vaginatum*, stand yield tables, simulation.

USDA Forest Service
General Technical Report RM-23

March 1976

User's Guide to SWYLD2: Yield Tables for Even-Aged and Two-Storied Stands of Southwestern Ponderosa Pine, Including Effects of Dwarf Mistletoe

Carleton B. Edminster and Frank G. Hawksworth

Introduction

Computer program SWYLD2 (Myers and others 1976) has been developed to compute yield tables for even-aged and two-storied stands of southwestern ponderosa pine (*Pinus ponderosa* Laws.), including effects of dwarf mistletoe (*Arceuthobium vaginatum* subsp. *cryptopodum* (Engelm.) Hawksw. & Wiens). Program SWYLD2 has been written to supersede program SWYLD (Myers and others 1972), and has the capability of handling a wider range of stand situations and management decisions. This report describes certain procedures for application of SWYLD2 in studying management alternatives for existing and hypothetical stands.

Stands to be analyzed using SWYLD2 should be even-aged or two-storied. In even-aged stands, diameters of most trees will not differ greatly from the average diameter of the stand. The diameter distribution will generally follow a unimodal distribution (fig. 1). Although the range of tree diameters in an even-aged stand will increase with stand age and time since treatment, stands with a range in diameters greater than 12 inches may not be even-aged (Hawksworth and Myers 1973) and may have to be treated as two-storied. Two-storied stands will appear to be two-aged, and ages of trees in the smaller diameter classes will be much less than ages of trees in the larger diameter classes. The diameter distribution of trees in a two-storied stand will generally follow a bimodal distribution (fig. 2). Two-storied stands may occur naturally or may result from a seed cut of a shelterwood followed by regeneration under the residual overstory.

The stand must be relatively uniform in species composition, site quality, stand structure, tree density, and past treatment. SWYLD2 may be used to predict yields in stands with or without dwarf mistletoe. In infested stands, dwarf mistletoe should be distributed fairly generally over the area. If part of the area is free of dwarf mistletoe, it should be analyzed as a separate stand. Stands of any size may be analyzed, since the yield tables give values for an average acre. Uniformity of site quality and stand characteristics must be such that site index and other area averages accurately describe the unit of forest analyzed. Stand area may range from a very few acres in rough terrain to a hundred or more acres where meaningful averages may be computed (Myers and others 1976).

Occasional trees of different species may be present in the stand being analyzed. These trees will be included in the stand data as though they

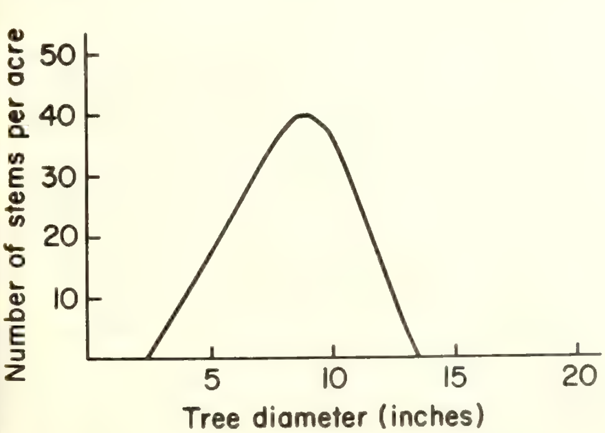

Figure 1.—Idealized diameter distribution for an even-aged stand.

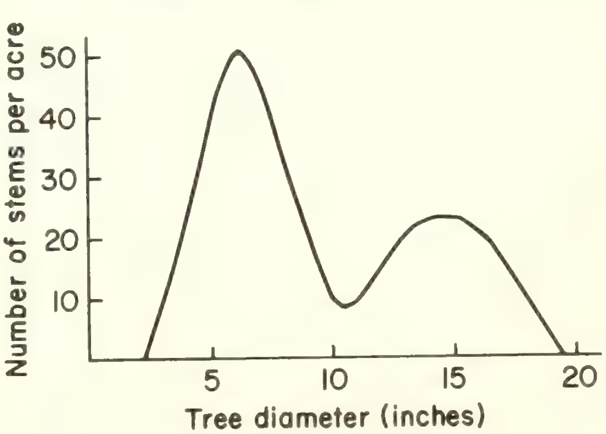

Figure 2.—Idealized diameter distribution for a two-storied stand.

are members of the main stand; they should be included in computations of average diameter and number of stems per acre. The amount of species variation that may exist before accuracy is significantly reduced will depend on the relative growth rate of the species (Hawksworth and Myers 1973). Generally no more than 10 percent of the trees should be of different species.

Dwarf Mistletoe

In SWYLD2, dwarf mistletoe infestation is measured by the 6-class rating system (Hawksworth 1961). A rating is obtained for each live tree, as shown in figure 3. In even-aged stands, the individual ratings are then averaged to obtain the value for the entire stand. In two-storied stands, separate averages are computed for the overstory and understory.

SWYLD2 allows information on the dwarf mistletoe infestation to be reported in one of three ways for an even-aged stand, or for each story in a two-storied stand: (1) average dwarf mistletoe rating (DMR), (2) percentage of infected live trees (PINF), or (3) age at time of initial infestation (START). Only one of these three alternatives should be used to report information on the infestation. If possible, DMR or PINF should be used. Walters (1975) describes sampling methods for determining the percentage of infected trees in southwestern ponderosa pine stands. START is not merely the age when the earliest infection occurred, but the mean age when infection began at various points throughout the stand. START may be difficult to obtain because it requires direct aging of infections, but may be useful in studying hypothetical stands for the development of management guidelines.

Control of Stand Density

Growing stock levels are used to specify the intensity of all partial cuts. Growing stock levels are designated by the square feet of basal area per acre desired when average stand diameter (d.b.h.) is 10 inches or more (Myers 1971). Basal area in a stand or story of smaller average d.b.h. is less than the designated level, as shown in figure 4 and table 1. In an even-aged stand, for example, if a growing stock level of 80 is desired and the stand is expected to have an average d.b.h. after thinning of 5.0 inches, the basal area to be retained is 46.8 square feet per acre. If a growing stock level of 100 is desired, (100/80) × 46.8, or 58.5 square feet per acre will be left (Hawksworth and Myers 1973). Table 1 can also be used to estimate the appropriate growing stock level if it is desired to leave a certain residual basal area for a given average d.b.h.

Table 2 relates average d.b.h. after thinning to average d.b.h. before thinning for various intensities of thinning. Table 3 relates the average spacing between residual trees to average d.b.h. after thinning for various growing stock levels. Table 4 relates the number of residual stems per acre to average d.b.h. after thinning.

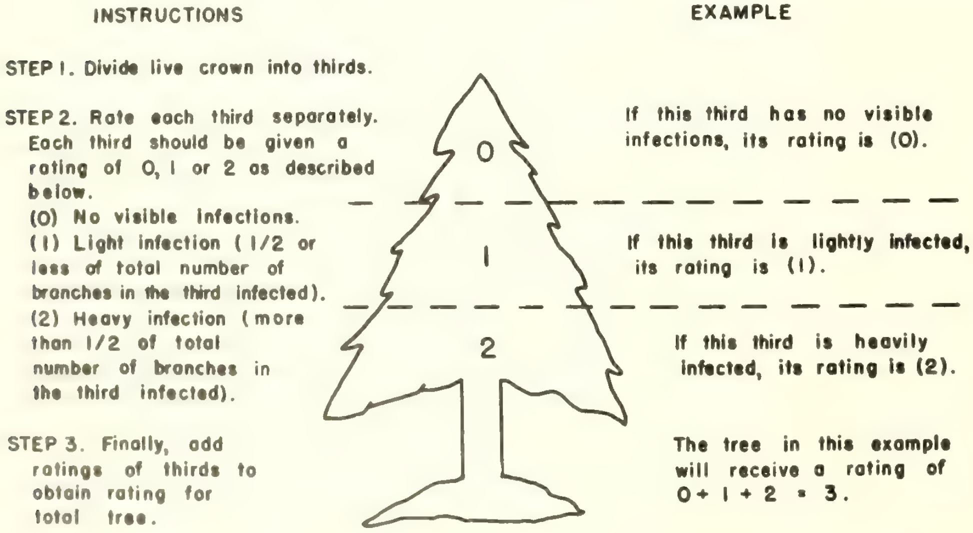
INSTRUCTIONS
EXAMPLE
STEP 1. Divide live crown into thirds.
STEP 2. Rate each third separately. Each third should be given a rating of 0, 1 or 2 as described below.
(0) No visible infections.
(1) Light infection (1/2 or less of total number of branches in the third infected).
(2) Heavy infection (more than 1/2 of total number of branches in the third infected).
STEP 3. Finally, add ratings of thirds to obtain rating for total tree.
0
1
2
If this third has no visible infections, its rating is (0).
If this third is lightly infected, its rating is (1).
If this third is heavily infected, its rating is (2).
The tree in this example will receive a rating of 0 + 1 + 2 = 3.

Figure 3.—Instructions for and example of the use of the 6-class mistletoe rating system (from Hawksworth 1971).

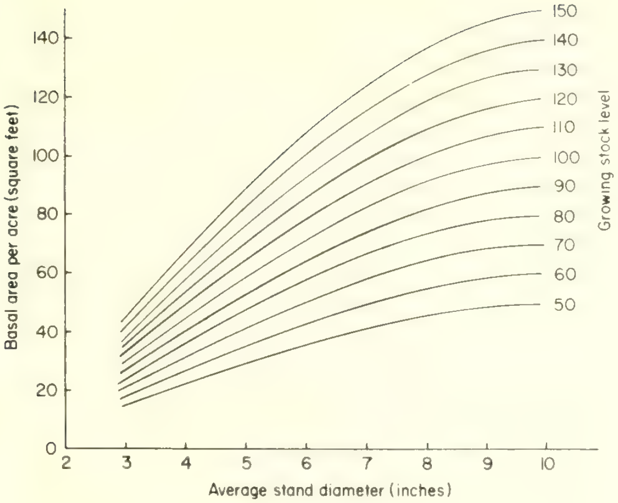

Figure 4.—Basal area after thinning in relation to average stand diameter for standard levels of growing stock (from Myers 1971).

SWYLD2 executes thinnings and regeneration cuts separately for each story in two-storied stands. Thus it is possible for the user to specify simultaneous cuttings in both the overstory and understory, or a cutting may be specified in only one story. Growing stock level specified for a cutting applies only to the basal area and average diameter of the story involved, and not to the combined basal area of both stories. A separate yield table is printed for each story in two-storied stands.

User-Supplied Information

Values of 38 variables that describe stand conditions or control program execution are read from data cards supplied by the program user. Names and definitions of these variables are given in the tabulation headed Contents of the Data Deck. Input formats and a sample data form are shown in figure 5. With the exception of card type 3, all data must be right-justified in the appropriate fields. Decimal points need not be punched, and are shown in figure 5 only for reference by the user.

The data deck for SWYLD2 consists of six different card types. Card types 1 and 2 appear at the beginning of the data deck. Only one set of these cards is read during a single computer run. Sets of card types 3, 4, 5, and 6 must appear for each different stand condition or set of management controls to be studied.

Table 1. Basal areas after partial cutting in relation to average diameter and growing stock level

Average d.b.h. after cutting (Inches)	Growing stock level						
	40	60	80	100	120	140	160
				- - - - *Square feet* - - - -			
1.0	3.0	4.5	6.0	7.5	9.0	10.5	12.0
1.5	4.6	6.8	9.1	11.4	13.6	15.9	18.2
2.0	6.0	9.1	12.1	15.1	18.2	21.2	24.2
2.5	9.0	13.4	17.9	22.4	26.8	31.3	35.8
3.0	11.8	17.8	23.7	29.6	35.6	41.5	47.4
3.5	14.8	22.1	29.5	36.9	44.2	51.6	59.0
4.0	17.6	26.4	35.2	44.0	52.8	61.6	70.4
4.5	20.5	30.8	41.0	51.2	61.5	71.8	82.0
5.0	23.4	35.1	46.8	58.5	70.2	81.9	93.6
5.5	25.9	38.8	51.8	64.8	77.7	90.6	103.6
6.0	28.3	42.4	56.6	70.8	84.9	99.0	113.2
6.5	30.6	45.9	61.2	76.5	91.8	107.1	122.4
7.0	32.7	49.0	65.4	81.8	98.1	114.4	130.8
7.5	34.6	51.9	69.2	86.5	103.8	121.1	138.4
8.0	36.2	54.4	72.5	90.6	108.8	126.9	145.0
8.5	37.6	56.5	75.3	94.1	113.0	131.8	150.6
9.0	38.8	58.1	77.5	96.9	116.2	135.6	155.0
9.5	39.6	59.3	79.1	98.9	118.6	138.4	158.2
10.0+	40.0	60.0	80.0	100.0	120.0	140.0	160.0

Table 2. Average diameters after partial cutting from below to various levels[1]

Average d.b.h. before cutting (Inches)	Percentage of trees retained								
	10	20	30	40	50	60	70	80	90
					- - - - *Inches* - - - -				
1.0	1.9	1.6	1.4	1.4	1.3	1.2	1.2	1.2	1.1
2.0	3.3	2.9	2.7	2.6	2.5	2.4	2.3	2.3	2.2
3.0	4.7	4.2	3.9	3.8	3.8	3.7	3.5	3.3	3.1
4.0	6.0	5.4	5.1	4.9	4.8	4.7	4.5	4.4	4.1
5.0	7.2	6.6	6.2	6.0	5.8	5.7	5.6	5.4	5.2
6.0	8.4	7.7	7.3	7.1	6.9	6.7	6.6	6.4	6.2
7.0	9.6	8.9	8.4	8.2	7.9	7.7	7.6	7.4	7.2
8.0	10.8	10.0	9.5	9.2	8.9	8.8	8.6	8.4	8.2
9.0	11.9	11.1	10.6	10.3	9.9	9.8	9.6	9.5	9.2
10.0	13.0	12.1	11.7	11.3	10.9	10.8	10.7	10.5	10.3
12.0	15.2	14.2	13.7	13.4	13.0	12.8	12.7	12.5	12.3
14.0	17.3	16.3	15.8	15.4	15.0	14.9	14.7	14.6	14.3
16.0	19.3	18.4	17.8	17.5	17.1	16.9	16.8	16.6	16.4
18.0	21.4	20.4	19.8	19.5	19.1	19.0	18.8	18.6	18.4
20.0	23.3	22.4	21.8	21.4	21.1	21.0	20.9	20.7	20.5
25.0	28.2	27.2	26.7	26.3	26.2	26.1	26.0	25.8	25.6
30.0	32.9	32.0	31.5	31.2	31.2	31.2	31.1	30.9	30.7

[1] These values are for healthy stands. In dwarf mistletoe-infested stands, the increase in average d.b.h. will be half the change indicated in the table.

Table 3. Average distance between residual trees in relation to average diameter and growing stock level

Average d.b.h. after cutting (Inches)	Growing stock level						
	40	60	80	100	120	140	160
			- - - - *Feet* - - - -				
1.0	8.9	7.3	6.3	5.6	5.1	4.8	4.4
2.0	12.5	10.2	8.9	7.9	7.2	6.7	6.3
3.0	13.4	11.0	9.5	8.5	7.8	7.2	6.7
4.0	14.7	12.0	10.4	9.3	8.5	7.9	7.3
5.0	15.9	13.0	11.3	10.1	9.2	8.5	8.0
6.0	17.4	14.2	12.3	11.0	10.0	9.3	8.7
7.0	18.9	15.4	13.3	11.9	10.9	10.1	9.4
8.0	20.5	16.7	14.5	13.0	11.8	10.9	10.2
9.0	22.3	18.2	15.8	14.1	12.9	11.9	11.1
10.0	24.4	19.9	17.2	15.4	14.1	13.0	12.2
12.0	29.2	23.9	20.7	18.5	16.9	15.6	14.6
14.0	34.1	27.9	24.1	21.6	19.7	18.2	17.1
16.0	39.0	31.8	27.6	24.7	22.5	20.8	19.5
18.0	43.9	35.8	31.0	27.7	25.3	23.4	21.9
20.0	48.7	39.8	34.5	30.8	28.1	26.1	24.4
25.0	60.9	49.7	43.1	38.5	35.2	32.6	30.5
30.0	73.1	59.7	51.7	46.2	42.2	39.1	36.6

Table 4. Number of residual stems per acre in relation to average diameter and growing stock level

Average d.b.h. after cutting (Inches)	Growing stock level						
	40	60	80	100	120	140	160
				- - - - Stems per acre - - - -			
1.0	553	830	1,107	1,383	1,660	1,937	2,213
2.0	277	415	553	692	830	968	1,107
3.0	241	361	482	602	723	843	964
4.0	202	303	404	505	606	707	808
5.0	172	258	343	429	515	601	687
6.0	144	216	288	361	433	505	577
7.0	122	184	245	306	367	428	489
8.0	104	156	208	260	312	364	415
9.0	88	132	175	219	263	307	351
10.0	73	110	147	183	220	257	293
12.0	51	76	102	127	153	178	204
14.0	37	56	75	94	112	131	150
16.0	29	43	57	72	86	100	115
18.0	23	34	45	57	68	79	91
20.0	18	28	37	46	55	64	73
25.0	12	18	23	29	35	41	47
30.0	8	12	16	20	24	29	33

Values of variables associated with the understory of two-storied stands on card types 4 and 5 should be left blank or set to zero if the stand being studied is even-aged. Only the stand and overstory values are used for even-aged stands.

As mentioned earlier, only one of the three alternative ways of reporting the level of a dwarf mistletoe infestation should be used. The values for the remaining two variables should be set to zero or left blank. Different alternatives may be used for each story in a two-storied stand. For example, average DMR might be used for an infested overstory and PINF for the understory.

The alternative of no management can be simulated by not performing any thinnings during the life of the stand. To suppress thinnings, the values of DELAY and JCYCL on card type 4 should be set to the difference between the removal age for clearcutting, REGN(1) on card type 6, and initial stand or story age, AGEO on card type 5.

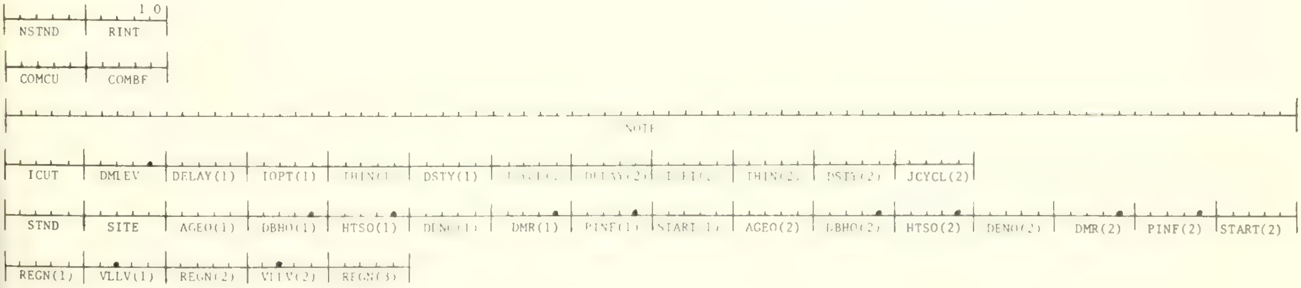

Figure 5.—Sample input data form for program SWYLD2 (decimal points are shown for user reference, and need not be punched).

Contents of the Data Deck

Card type 1—header:

NSTND — Number of sets of stand records to be processed in a single computer run. This is the number of sets of card types 3, 4, 5, 6 to follow in the data deck.

RINT — Number of years in a projection of growth or change. The value of RINT is 10.0 for the equations in SWYLD2.

Card type 2—commercial limits:

COMCU — Minimum cut in merchantable cubic feet per acre to be included in total yields. The value of COMCU is also used to determine if a thinning meets commercial limits, if any are imposed. See ICUT, card type 4. COMCU must have a value of at least 1.0.

COMBF — Minimum cut in board feet per acre to be included in total yields. The value of COMBF is also used to determine if a thinning meets commercial limits, if any are imposed. See ICUT, card type 4. COMBF must have a value of at least 1.0.

Card type 3—stand identification:

NOTE — Stand identification and description of test conditions. May be up to 80 characters long including blanks.

Card type 4—controls for thinnings:

ICUT — Control variable to determine the number of noncommercial thinnings that will be executed. A value of zero (0) causes all noncommercial thinnings to be bypassed. A value of one (1) allows only the initial thinning in the stand or a story to be noncommercial. Subsequent noncommercial thinnings will be bypassed. A value of two (2) allows all scheduled thinnings to be noncommercial. The values of COMCU and COMBF (card type 2) specify the minimum commercial limits.

DMLEV — Dwarf mistletoe rating above which thinnings will not be performed. Experience in ponderosa pine stands indicates that thinnings cannot materially reduce effects of the infestation or improve stand growth when DMR exceeds 3.0 (Myers and others 1976). Regeneration cuts will be performed when they are scheduled even if DMR exceeds DMLEV.

DELAY(1) — Number of years between initial age in yield table and first cut in the overstory. The value of DELAY(1) must be a multiple of the value of RINT (card type 1). DELAY(1) will have a value of zero if a cutting is desired at the initial age of the overstory in the yield table (AGEO(1), card type 5). An overmature overstory may be held past the normal final removal age, largest REGN (card type 6), by specifying a value of DELAY(1) equal to the difference between the desired removal age and the value of AGEO(1).

IOPT(1) — Control to specify whether the initial thinning in an infested overstory will be from above or below. Thinning from above emphasizes, but is not restricted to, removal of the larger trees. Such cutting is usual practice in infested stands because the larger trees usually support the greater amounts of dwarf mistletoe. IOPT(1) is assigned a value of zero (0) if initial thinning is to be from above, and a value of one (1) if the initial thinning is to be from below. If the initial cut in the overstory is a regeneration cut, the cutting will be from below regardless of the value of IOPT(1).

THIN(1) — Growing stock level for initial thinning in the overstory. Values for THIN(1) will frequently be 80 to 100, but may range from 40 to 160. When thinning from above with THIN(1) assigned a value greater than 60.0, SWYLD2 reduces the value of THIN(1) to simulate additional removals for control purposes. The amount of reduction is based on the initial DMR and is given by the formula DMR/3.0 × (THIN - 60.0). If the initial DMR is greater than 3.0, then SWYLD2 assigns THIN(1) a value of 60.0 unless a lower input value is specified.

DSTY(1) — Growing stock level for intermediate cuts after the first in the overstory. Value for DSTY(1) may be the same as the value for THIN(1). Values for DSTY(1) will also frequently be 80 to 100, but may range from 40 to 160.

JCYCL(1) — Interval in years between intermediate cuts in the overstory. The value of JCYCL(1) must be a nonzero multiple of the value of RINT (card type 1).

DELAY(2) — Number of years between initial age in yield table and first cut in the understory. With the exception of holding an overmature overstory, the discussion of DELAY(1) also applies to DELAY(2).

IOPT(2) — Control to specify whether the initial thinning in an infested understory will be from above or below. The discussion of IOPT(1) also applies to IOPT(2).

THIN(2) — Growing stock level for initial thinning in the understory. The discussion of THIN(1) also applies to THIN(2).

DSTY(2) — Growing stock level for intermediate cuts after the first in the understory. The discussion of DSTY(1) also applies to DSTY(2).

JCYCL(2) — Interval in years between intermediate cuts in the understory. The discussion of JCYCL(1) also applies to JCYCL(2).

Card type 5—stand conditions:

STND — Identification number of the stand.

SITE — Site index of the stand based on mean height of dominant and codominant trees in the overstory at total base age 100 years. Tables and graphs published by Meyer (1938) are appropriate. The value of SITE must be a reliable indicator of relative productivity. Trees in dense stands or with any disease or deformity that may reduce height growth do not furnish reliable information. In such cases, site index can be obtained from suitable nearby stands or from soil variables.

AGEO(1) — Mean total age in years of live overstory dominant and codominant trees at the first entry in the yield table.

DBHO(1) — Mean diameter breast height of all live overstory trees at age AGEO(1), regardless of crown class or species. The value of DBHO(1) should be determined to the nearest 0.1 inch. Average d.b.h. is the diameter of the tree of average basal area.

HTSO(1) — Mean height in feet of live overstory dominant and codominant trees at age AGEO(1). The value of HTSO(1) may be left blank when examining hypothetical stands with a density below growing stock level 160. For actual stands, the value of HTSO(1) should be determined from field measurements to account for the past effects of stand density and disease on height growth.

DENO(1) — Number of all live overstory trees per acre at age AGEO(1), regardless of crown class or species. Only trees over 4.5 feet tall should be counted.

DMR(1) — Average dwarf mistletoe rating of all live overstory trees at age AGEO(1).

PINF(1) — Percentage of the live overstory trees infected with dwarf mistletoe at age AGEO(1).

START(1) — Age of the overstory trees in years when the dwarf mistletoe infection began or is expected to begin in the overstory at various points throughout the stand. For an uninfested overstory, the value of START(1) must be greater than the largest REGN (card type 6).

AGEO(2) — Mean total age in years of live potential dominant and codominant trees in the understory at the first entry in the yield table.

DBHO(2) — Mean d.b.h. of all live understory trees at age AGEO(2), regardless of crown class or species. The discussion of DBHO(1) also applies to DBHO(2).

HTSO(2) — Mean height in feet of live potential dominant and codominant trees in the understory at age AGEO(2). The discussion of HTSO(1) also applies to HTSO(2).

DENO(2) — Number of all live understory trees, over 4.5 feet tall, per acre at age AGEO(2).

DMR(2) — Average dwarf mistletoe rating of all live understory trees at age AGEO(2).

PINF(2) — Percentage of the live understory trees infected with dwarf mistletoe at age AGEO(2).

START(2) — Age of the understory trees in years when the dwarf mistletoe infection began or is expected to begin in the understory at various points throughout the stand. The discussion of START(1) also applies to START(2).

Card type 6—controls for regeneration cuts:

REGN(1) — Stand age in years when the first regeneration cut will occur. Must never be zero or blank. The value of REGN(1) is the age for clearcutting if the remainder of card type 6 is left blank. The value of REGN(1) must be equal to the values of AGEO for each story (card type 5) plus multiples of the value of RINT (card type 1). Therefore, it may be necessary to round off the values of AGEO(1) and AGEO(2) to the nearest ten years if the value of REGN(1) is a multiple of ten.

VLLV(1) — Percentage, as a decimal, of growing stock level for previous intermediate cuts, DSTY(1) and DSTY(2) (card type 4), to be retained at age REGN(1). Leave this and the next three variables blank if a clearcut system is being used.

REGN(2) — Stand age in years when the second regeneration cut, if any, will occur. This is the age when the final cut of a two-cut shelterwood or the second cut of a three-cut shelterwood will occur. The value of REGN(2) must be equal to the value of REGN(1) plus a nonzero multiple of the value of RINT (card type 1).

VLLV(2) — Percentage, as a decimal, of growing stock level retained after the first regeneration cut to be retained at age REGN(2). Leave this and the next variable blank if a two-cut shelterwood system is being used.

REGN(3) — Stand age in years when the third regeneration cut, if any, will occur. This is the age when the final cut of a three-cut shelterwood will occur.

Literature Cited

Hawksworth, Frank G.
1961. Dwarfmistletoe of ponderosa pine in the Southwest. U.S. Dep. Agric., Tech. Bull. 1246, 112 p.

Hawksworth, Frank G., and Clifford A. Myers.
1973. Procedures for using yield simulation programs for dwarf mistletoe-infested lodgepole and ponderosa pine stands. USDA For. Serv. Res. Note RM-237, 4 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Meyer, Walter H.
1938. Yield of even-aged stands of ponderosa pine. U.S. Dep. Agric. Tech. Bull. 630, 59 p.

Myers, Clifford A.
1971. Field and computer procedures for managed-stand yield tables. USDA For. Serv. Res. Pap. RM-79, 24 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Myers, Clifford A., Frank G. Hawksworth, and Paul C. Lightle.
1972. Simulating yields of southwestern ponderosa pine stands, including effects of dwarf mistletoe. USDA For. Serv. Res. Pap. RM-87, 16 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Myers, Clifford A., Carleton B. Edminster, and Frank G. Hawksworth.
1976. SWYLD2: Yield tables for even-aged and two-storied stands of southwestern ponderosa pine, including effects of dwarf mistletoe. USDA For. Serv. Res. Pap. RM-163, 25 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

Walters, James W.
1975. Evaluation of a dwarf mistletoe survey procedure. USDA For. Serv., For. Insect and Dis. Manage. Rep. R-3, 75-23, 7 p. Southwest. Reg., Albuquerque, N.M.

Edminster, Carleton B., and Frank G. Hawksworth.
1976. User's guide to SWYLD2: Yield tables for even-aged and two-storied stands of southwestern ponderosa pine, including effects of dwarf mistletoe. USDA For. Serv. Gen. Tech. Rep. RM-23, 8 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

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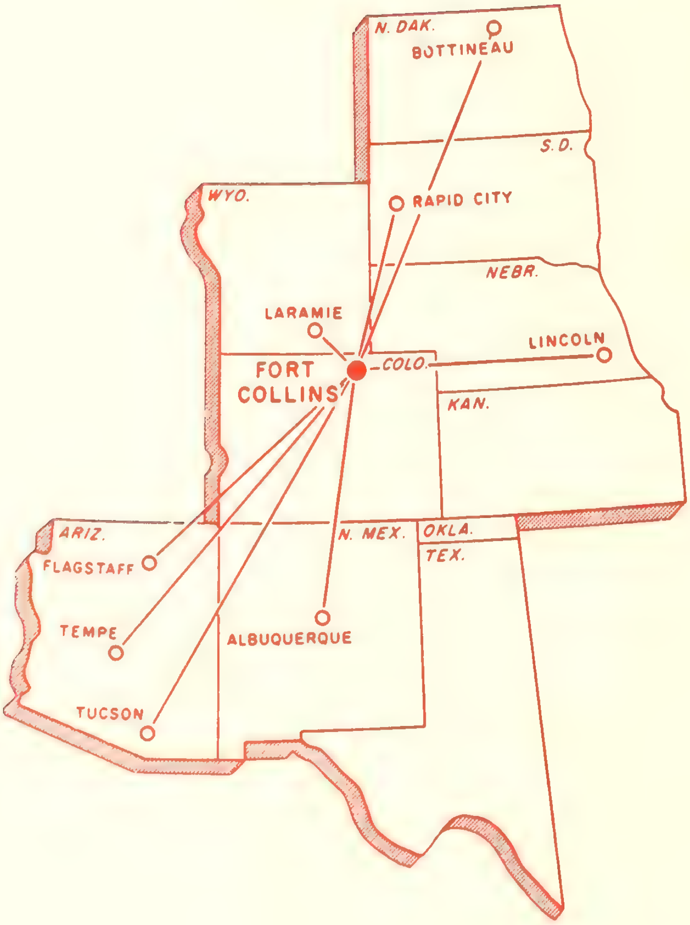
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